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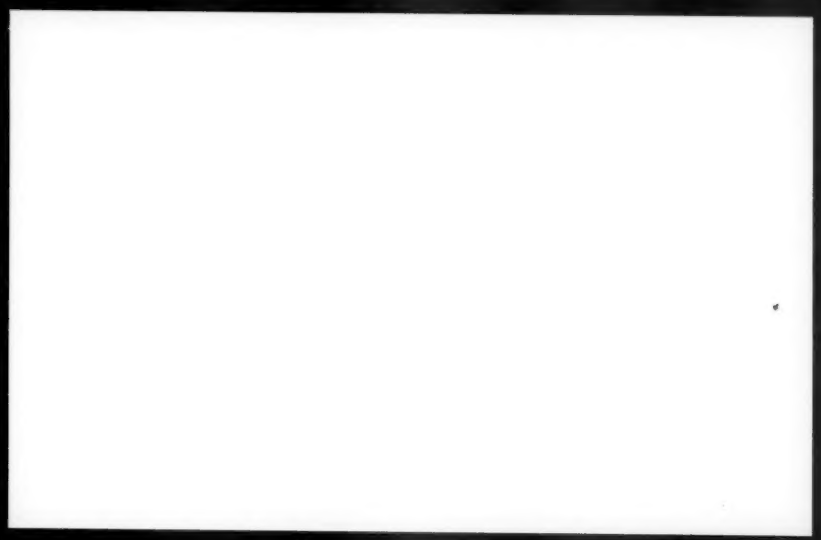

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Methods of compliance with fracture toughness and operational requirements of 10 CFR 50, appendix G, 3:639 (BAW–10046A(Rev.1))

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Abey, A.E., Apparatus for deformation tests at intermediate strain rates—10^{-2} to 10^{-3} s^{-1}—and at high pressure, 3:1118 (UCRL–79012)
Abou-Sayed, A.S., *See* Jones, A.H., 3:202

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Volume 4, Number 1, February 15, 1979

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 5451, 6083, 6084

4941 **Symposium on thermal hydrocarbon chemistry.** Washington, DC; American Chemical Society (1978). 404p. (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Thirty-seven papers presented at the symposia are included in Volume 23, No. 1. A separate abstract was prepared for each paper for ERA, four papers were also abstracted for EAPA. (JRD)

4942 **Congressional view of the Federal energy policy.** Yamagata, B. (Committee on Energy Natural Resources, Washington, DC). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 368-370(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The US energy policy is reviewed emphasizing coal resources. It is noted that coal liquefaction, though perhaps the most important, is some time into the future. The Senate has supported the funding of several large pilot plants which are large enough so that a company could scale up tp a commercial-sized operation, thus avoiding the so-called "demonstration plant" stage. This is a marked departure from funding on other pilot plants and, to me, makes a good deal of sense. Coal gasification, if to produce a low Btu gas, enjoys growing interest in the Senate. The Senate recently authorized the expenditure of 40 million dollars, if the money is made available, to demonstrate gasification processes for use with industrial and electric utility boilers. The time is fast approaching when private industry should be converting to low Btu gas on its own. With respect to the direct combustion of coal, the fluidized bed boiler enjoys Congressional support and, according to some experts, is the electric utilities technology of the future. Other topics discussed include oil company divestiture, private investment in energy R and D, energy conservation measures, and the effects of single governmental department jurisdiction over energy R and D. (JRD)

PROCESSING

REFER ALSO TO CITATION(S) 5323, 5711, 6089

4943 (ORNL—5383, pp 7-22) **Coal conversion and utilization.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

During this report period, the activities related to coal conversion process development encompassed four areas: (1) continuing effort on the hydrocarbonization of coal, (2) continuing effort on the pyrolysis of coal blocks to provide supporting data for in situ gasification, (3) completion of our investigation of carbonization of liquefaction residues, and (4) three preliminary investigations supporting coal liquefaction.

4944 (ORNL—5383, pp 54-67) **Biotechnology and environmental studies.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

This program is concerned with the development of biochemical engineering technology whereby individual process steps, at least one of which utilizes a biological entity, can be integrated to result in a highly useful overall process. Areas of concern to DOE that will benefit directly from this technology include energy production and conservation, resource recovery, and pollution abatement. Investigations specific to problems in nuclear waste management include the removal of radionuclides and chemical contaminants from aqueous process and effluent streams. Bioengineering research activities were focused on three areas during this reporting period: enzyme catalysis; treatment of aqueous effluents from coal conversion processes; and bioreactor scale-up and process modeling studies.

4945 **Preventing gas explosions in thermal coal conversion plants.** Murke, K. *Neue Bergbautech.;* **7**: No. 8, 591-596(Aug 1977). (In German).

The conditions under which combustible gases may mix with air or oxygen in processes which include the heat treatment of coal are discussed, together with the most important practical measures to be taken to prevent the occurrence of explosive mixtures.

CARBONIZATION

REFER ALSO TO CITATION(S) 5091, 5143, 5148

4946 **Process for carbonizing lignite coal.** Elberg, A.J. (to Husky Industries Inc.). US Patent 4,100,032. 11 Jul 1978. Filed date 25 Jul 1977. 12p.

A process for carbonizing lignite coal in a Herreshoff Carbonizer of a multi-hearth type is described. The novel process comprises the steps of introducing given quantities of lignite in the first and succeeding hearths while introducing sufficient quantities of combustion air and fuel to ignite the fuel and to raise the temperature of the hearths until the process is self-sustaining as a result of the combustion of the volatiles driven off of the lignite. The hearth temperatures range approximately 1450 to 1620°F in the first furnace hearth with the second furnace hearth ranging approximately 1650 to 1800°F and the third furnace hearth ranging approximately 1650 to 1890°F. Sufficient combustion air is introduced into various hearths of the furnace to insure complete combustion in at least the first hearth and in the stack of the volatiles being driven off thereby making the process self-sustaining, allowing the introductory fuel to be cut off. The final volatile content of the specification char made in the furnace from the lignite is controlled by utilizing the remaining succeeding hearths in the furnace with the temperatures ranging in these hearths approximately 900 to 1250°F. The specification char thereby made in the furnace is a char manufactured to a definite residual volatile content.

4947 **Quenching method.** Smith, J.B.; Haley, J.R. (to Peabody Coal Co.). US Patent 4,100,034. 11 Jul 1978. Filed date 19 Jul 1976. 4p.

A column of hot, particulate char from a shaft furnace is moistened with quench water as it moves downwardly into a vessel which it fills and forms a pile. The material in the pile is shifted from a central core at the base of the column to a zone which surrounds the sides and bottom of the column by material flowing from the lower portion of the column; and steam is exhausted from the upper portion of the vessel.

4948 **Better electrodes from high purity coke.** *Electr. Times;* No. 4470, 6(14 Apr 1978).

Brief details are given of work at NCB's Coal Research Establishment on electrodes for steel arc furnaces and aluminium refining, heat shrinkable plastics, and aspects of fluidized bed combustion. The information was obtained from the Establishment's annual report.

4949 **Cokemaking facilities at Redcar: a new development in coke-production.** *Steel Times;* **206**: No. 3, 62-70(Mar 1978).

The cokemaking plant at Redcar uses the Coaltek charge preheating and pipeline charging system. The advantages of this system are presented and the equipment used is described in some detail.

4950 Nature of coking coals. Jasienko, S. *Fuel;* **57**: No. 3, 131-146(Mar 1978).

A review of the properties and the structure of coals occupying the middle position in the coalification scale that show the best coking properties--gas coals, gas-coking coals, ortho, meta and semi-coking coals--with particular regard to their behavior on heat treatment is presented. Problems of coking coals as components of blends in the production of metallurgical coke, as component and binding agent in the process of obtaining metallurgical formed-cokes, and the utilization of coking coals and their extracts as a raw materials in the electrode industry, are discussed. The classification of coking coals and questions still to be solved concerning the origin, properties, structure and rational utilization of coking coals, are commented on. An extensive bibliography is included.

4951 Kinetics of coke formation from coal solutions. Rantell, T.D.; Clarke, J.W. *Fuel;* **57**: No. 3, 147-150(Mar 1978).

The reaction kinetics for the formation of mesophase from coal solutions has been studied under conditions similar to those experienced in a delayed coker preheater coil, i.e. at temperatures from 475 to 525°C approached at high heating rates. The degree of polymerization of the heat-treated materials has been assessed by their solubility in two solvents, cyclohexane and quinoline. An approximation has been made in order to make a kinetic analysis for the formation of insolubles in a nonisothermal system. It has been found that the polymerization of the dissolved coal component, as evidenced by the formation of quinoline insolubles during the heat-treatment of concentrated coal solutions, is essentially a second-order reaction with an apparent activation energy of 190kJ/mol. The formation of cyclohexane insolubles from the diluent oil is a slower reaction showing first-order kinetics.

4952 Mild hydrocarbonization of western coal. Cochran, H.D. Jr.; Holmes, J.M. (Oak Ridge National Lab., TN). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 163-174(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Experimental hydrocarbonization results are presented and a process flowsheet is described. It is noted that at present, this conceptual coal conversion process is limited in its application to western coals because of their noncaking character and lower sulfur content as compared with eastern bituminous coals. It is of interest to note, however, that certain chemical pretreatment processes have been shown to eliminate the caking tendency of the coal and reduce its sulfur content. Recent experiments at ORNL have confirmed the suitability of several chemically treated coals to mild hydrocarbonization. There is evidence to suggest that some of these pretreated coals are actually more reactive, under hydrocarbonization conditions, than untreated coal, thereby enhancing the yield of oil and/or gas. It is concluded from this preliminary study that processes based on the mild hydrocarbonization of western coal appear to be technically and economically feasible. A proposal was made to DOE that a more thorough evaluation of the process concept be undertaken. The institutional that might be associated with a process producing power, gas, and oil for sale, are recognized, however they are small in comparison with the problems associated with other processes which appear to be less likely to yield profits attractive to industry.

4953 Measurement of air pollution emissions from coke oven doors. Kelsey, S.F. Pittsburgh; Carnegie-Mellon Univ. (1978). 157p. University Microfilms Order No. 78-07,186.

Thesis (Ph. D.).

The thesis analyzes data and considers statistical issues arising from the measurement of visible air pollution emissions from coke oven door leaks. Data was collected at coke plants in Allegheny County, Pennsylvania by inspectors of the County Bureau of Air Pollution Control and by employees of United States Steel Corporation. The estimates of error probabilities are small and so it is concluded that the inspection procedure is reliable. Time series of the proportion of leaking coke oven doors on a battery are examined for the purpose of determining whether the situation is improving and for discovering patterns that suggest reasons for leaking doors. Statistical issues arising from the available data set are missing values, unevenly spaced observations and limited length of series. The estimation of the spectral density of the series suggests a weekly cycle which is possibly the result of maintenance schedules. The study provides insight into the problem of setting environmental standards. Both those responsible for design and those responsible for enforcement must recognize that quantities do vary over time and that procedures used to measure these quantities are not free from error. Ideal standards are not only practical for both industry and enforcement agencies but also allow for the collection of data that are amenable to statistical analysis.

4954 Plastic behavior of coals during temperature carbonization and gasification under high pressures. Kroeger, C.; Benke, U. *Glueckauf-Forschungsh.;* **37**: No. 3, 131-135(Jun 1976).

The caking of coals during low temperature carbonization and gasification under high pressures has been studied. Tests were carried out in an autoclave and in a through-flow reactor at pressures of 20, 40, and 80 bar in a nitrogen and a hydrogen atmosphere. The caking capacity of the coal was found to depend on the degree of coalification and on the parameters such as the flow conditions and the rate of heating. The hydrogen-carbon ratio and the volatile content of the coke produced under different conditions were measured.

4955 Ekonomicheskaya effektivnost' avtomatizatsii proizvodstva v ugol'noi promyshlennosti. (Economic efficiency of processing automation in the coal industry). Lazukin, N.Ya.; Al'tshuler, Z.E. Mowcow; Nedra (1976). 184p. (In Russian).

The book is concerned with the state of automated production processes and automated systems for the control of engineering processes in mines, mine pits and coal-enrichment plants. An examination is made of factors which determine the economic effectiveness of automation and their quantitative values, and the effect of automated production and the reliability of automated equipment on the operation of engineering equipment are indicated. Basic methodical hypotheses are presented for evaluating the economic effectiveness of automated production and operational-dispatcher control at coal enterprises, and methods are presented for evaluating the optimal operational expenditures required for maintaining automatic systems and methods for determining the perfection level of automatic control of engineering processes as well as the fundamentals for the scientific forecasting of automation development at coal industry enterprises. The book is intended for engineering-technical personnel at mines, mine pits and processing plants, planning-design and scientific-research institutes of the coal industry.

4956 Production of form-coke for metallurgical processes from fine grain low-temperature-carbonized impure lignite cokes. Kemal, M. Clausthal, Ger.; Technische Univ. (1974). 210p. (In German).

Thesis.

The coking behavior of mixtures of impure lignite cokes and bituminous coals as briquettes with various binders was examined and the properties of the form-cokes produced investigated. Characterization of reductive ability was made by means of Boundard reaction tests with CO_2 at 1000°C. Cokes with compressive strengths of 160 to 180 kp/cm² and abrasion values of 2-3% suitable for blast furnace use were produced. Resistivity values of (7-8) x 10^{-2} omega cm were recorded for certain mixtures and these are suitable for use in low shaft electric furnaces. Further properties and possible applications of various mixtures of lignite cokes are described.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 4975, 5021, 5196

4957 (FE—2344-T1) **Comparative engineering and cost analysis of coal beneficiation processes.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 20 Mar 1978. Contract EX-76-C-01-2344. 84p. Dep. NTIS, PC A05/MF A01.

This study provides a means of assessing developing coal beneficiation technologies in terms of unit-cost, sulfur-removal effectiveness, and market potential. EEA conducted an engineering and cost analysis of oxydesulfurization; developed a comparative methodology which can be applied to any beneficiation technology; used the methodology to compare oxydesulfurization, a developing beneficiation technique, with flue gas desulfurization (FGD), currently the most effective means of reducing sulfur emissions; and conducted a preliminary analysis of two other developing beneficiation technologies, the Ames process and the GE-RSD Microwave Desulfurization process. EEA's assessment of oxydesulfurization showed it to be a viable coal-cleaning technique, although further laboratory research is required for optimization. More than 90% of the inorganic sulfur and up to 40% of the organic sulfur can be removed from coal with this process treatment. The capital cost for one million Btu's per hour of production capacity is $18,500.00. EEA's analysis showed that, if reactor pressure and residence times could be decreased to 100 psia and 15 minutes (base case conditions: 1000 psia and 30 minutes) this cost could be reduced 50% and, therefore, oxydesulfurization would be competitive with FGD. Treatment costs are nearly equal for continuous and batch operation modes for this process.

4958 (FE—2579-18) **Granular bed filter development program. Theoretical analysis of granular bed filtration principles and performance prediction.** Wigton, H.; Wade, G. (Combustion Power Co., Inc.,

Menlo Park, CA (USA)). Jan 1978. Contract EF-77-C-01-2579. 253p. Dep. NTIS, PC A12/MF A01.

The purpose of theoretical investigations has been to identify and define key relationships to be incorporated in a computerized model of GBF performance. Successful implementation and development of such an analytical tool was expected to yield a number of potential applications and benefits: the understanding of physical principles and mechanisms contributing to observed filter performance and recognition of those mechanisms that have negligible influence; interaction between the model results and an ongoing experimental program to build confidence and improve accuracy in the former, and provide useful direction to the latter; guidance for empirical correlations of experimental data in the choice of promising forms, etc., by reference to available computer solutions; model extension to predict performance for new designs, conditions, and applications; and use of the model to search for optimal operating conditions, and to define sensitivities. In addition, the traditional justification for simulators--to generate solutions that simultaneously satisfy a large number of interacting relationships in a consistent, accurate, and repeatable manner--applies with special force to the GBF situation. This task paralleled the cold-flow filter model design, installation and testing effort. Early literature search and consultant services yielded equation development and identification of major filtration coefficients which, when applied to mathematical models and computer programming, provided filter performance solutions for all parameters under consideration. The correlation of these theoretical results with data from on-going experiments permitted an upgrading of the model, thus providing a firm data base with which to design future hot-flow filters.

4959 Desulfurization of fuel gas at high temperature using supported molten metal carbonate absorbent. Wolk, R.H.; Rovesti, W.; Maruhnic, P. (to Hydrocarbon Research Inc.). US Patent 4,100,107. 11 Jul 1978. Filed date 28 Nov 1975. 8p.

Sulfur compounds contained in fuel gases produced from the gasification of coal or petroleum residua are removed at about 1600°F temperature by contacting the gas with an absorbent material comprising a strong, macroporous particulate solid support containing molten metal carbonate, such as potassium carbonate, within its pores. Following such contacting and reaction of the sulfur compounds in the hot gas with the supported metal carbonate absorbent, it is regenerated by being contacted at high temperatures with steam and CO_2 to remove the sulfur, which is recovered as H_2S. The metal carbonate absorbent material is reused by again contacting it with the hot fuel gas for sulfur removal, after which the sulfur-free fuel gas is burned in a combustion process such as a gas turbine to produce power.

4960 Removal of impurities from coal. Kindig, J.K.; Turner, R.L. (to Hazen Research, Inc.). US Patent 4,098,584. 4 Jul 1978. Filed date 10 Feb 1977. 10p.

The magnetic susceptibility of various impurities contained within coal is increased by simultaneously cotreating the coal with a metal containing compound and a gas selected from the group consisting of hydrogen and carbon monoxide.

4961 Method of removing ash components from high-ash coals. Tippmer, K. (to Firma Carl Still Recklinghausen). US Patent 4,098,583. 4 Jul 1978. Priority date 19 Mar 1976, German, Federal Republic of (F.R. Germany). 6p.

A method of removing ash components from coals, particularly high-ash bituminous and sub-bituminous coals, comprises grinding the coals and suspending the ground coal in an aqueous media to form a raw suspension, fusing the raw suspension and without further additives stirring for 60 to 360 minutes at from 250 to 350°C and at a pressure of from 50 to 80 atm. Thereupon, the fused suspension is cooled and the pressure thereof is relieved. The aqueous phase containing the dissolved ash components is separated from the coal.

4962 Catalytic effect of active metals upon hydrodenitrogenation of heavy coal liquids. Kang, C.C. (Hydrocarbon Research, Inc., Lawrenceville, NJ). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 277-287(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Activities are reported in a program to develop an improved denitrogenation catalyst for heavy coal-derived fuel oil. It was found that for denitrogenation of coal derived fuel, Ni—Mo is more effective than Co—Mo, and Co—Mo is better than Ni—W. Initial catalyst deactivation is caused mainly by carbon deposition. Higher temperature operation results in higher carbon deposition on the catalyst and gives poor performances in terms of denitrogenation, desulfurization, deoxygenation and 975°F+ conversion.

4963 Catalytic hydroprocessing of solvent refined coal. Givens, E.N.; Collura, M.A.; Skinner, R.W.; Greskovich, E.J. (Air Products and Chemicals, Inc., Allentown, PA). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 288-306(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Activities are reported in a program to characterize the physical and chemical properties of solvent refined coal (SRC) and its derivatives, to develop technology for the desulfurization, denitrogenation, and hydrocracking of SRC using commercially available catalysts and to determine the bulk handling characteristics of SRC. Information and data are included on properties of Tacoma filtrate made from Kentucky coal, filtrate processing, and processing SRC filtrate. (JRD)

4964 Merits of acid-gas removal processes. Christensen, K.G.; Stupin, W.J. *Hydrocarbon Process.;* **57**: No. 2, 125-130(Feb 1978).

The most economic processes for removing acid gases in coal gasification are determined by the partial pressure of the acid gases. Comparison of absorption units shows that the Selexol process is most economic when the partial pressure of the acid gas is above about 200 psi and that the hot carbonate processes are preferred at lower partial pressures.

4965 Conditions and possibilities of Hungarian coal mining in connection with the reduction of sulfur and soot emissions. Takacs, P. *Publ. Hung. Min. Res. Inst.;* No. 19, 181-189(1976). (In French).

The sulfur contents of the main Hungarian coal deposits are listed. The results to be achieved by mining low-sulfur coals, removing pyrite, and using thermal treatment to upgrade coals are analyzed.

HYDROGENATION

REFER ALSO TO CITATION(S) 5021, 5044, 5051

4966 Process for producing benzene. Beuther, H.; Montagna, A.A. (to Gulf Research and Development Co.). US Patent 4,090,942. 23 May 1978. Filed date 29 Oct 1976. 4p.

A process for preparing benzene which involves heating a hydrocarbon stock containing polynuclear aromatic rings and having critical hydrogen to carbon atomic ratios in the presence of hydrogen under critical reaction conditions is discussed.

4967 Comparison of results obtained from different types of hydrogenation reactors using anthracene oil. Rash, D.; White, N. *Fuel;* **57**: No. 3, 184-185(Mar 1978).

Much of the research work on coal conversion has been done in batch autoclaves, but in commercial plants it is more likely that coal would be hydrogenated in a continuous process. A comparative study was carried out of the hydrogenation, under similar conditions, of a light anthracene oil in a rocking and a stirred autoclave, and in a continuous flow reactor similar to that used in the synthoil process. The continuous reactor yielded a much more saturated product with a lower mean boiling point. It is suggested that when using a pelletized catalyst and a batch reactor, crushing the catalyst gives better simulation of a continuous reactor.

GASIFICATION

REFER ALSO TO CITATION(S) 4954, 5042, 5062, 5076, 5140, 5141, 5142, 5225, 5239, 5406, 5407, 5434, 5452, 5982, 6015, 6819

4968 (ANL-FE—49622-12) Instrumentation and process control for fossil demonstration plants. Annual technical progress report, October 1976—September 1977. LeSage,L.G.; O'Fallon, N.M. (Argonne National Lab., IL (USA)). Oct 1977. Contract W-31-109-ENG-38. 155p. Dep. NTIS, PC A08/MF A01.

Progress on Instrumentation and Process Control for Fossil Demonstration Plants (FDP) is reported. Work has been performed on updating the study of the state-of-the-art of instrumentation for FDP, development of mass-flow and other on-line instruments for FDP, process control analysis for FDP, and organization of a symposium on instrumentation and control for FDP. A Solids/Gas Flow Test Facility (S/GFTF) under construction for instrument development, testing, evaluation, and calibration is described. The development work for several mass-flow and other on-line instruments is described: acoustic flowmeter, capacitive density flowmeter, neutron activation flowmeter, gamma ray correlation flowmeter, optical flowmeter, composition analysis system, and capacitive liquid interface level meter.

4969 (CONF-771203—, pp 140-142) Catalytic gasification of coals pretreated with liquid ammonia. Tamai, Y.; Iwasaki, H.; Fujinawa, K.; Ishii, H.; Matsuda, M.; Nishiyama, Y. (Tohoku Univ., Sendai). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4970 (CONF-771203—, pp 143-144) **Instrumentation needs in advanced coal utilization.** Raptis, A.C.; O'Fallon, N.M.; Cohn, C.E.; Doering, R.W.; Duffey, D.; Herzenberg, C.L.; Managan, W.W.; Porges, K.G. (Argonne National Lab., IL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4971 (CONF-771203—, pp 145) **Chemical solutions to problems encountered in the gasification of coal.** Kittle, P.A.; Bennett, R.J. (Apollo Chemical Corp., Whippany, NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4972 (CONF-771203—, pp 147-149) **Evaluation of integrated water-splitting/coal gasification processes.** Foh, S.E.; Gahimer, J.S. (Inst. of Gas Tech., Chicago). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4973 (CONF-771203—, pp 151-152) **Comparison of coal and biomass as feedstocks for synthetic fuel production.** Antal, M.J. (Princeton Univ., NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4974 (CONF-771203—, pp 699-701) **Numerical simulation model for entrained flow coal gasification. I. The hydrodynamical model.** Blake, T.R.; Brownell, D.H. Jr.; Schneyer, G.P. (Systems, Science and Software, La Jolla, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4975 (CONF-771203—, pp 707) **Coal gasification-gas cleaning pilot plant.** Ferrell, J.K.; Rousseau, R.W.; Felder, R.M.; Alexander, D.W. (North Carolina State Univ., Raleigh). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4976 (CONF-771203—, pp 41-42) **HYGAS: a process ready for commercial demonstration.** Lee, B.S. (Inst. of Gas Tech., Chicago). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4977 (CONF-771203—, pp 47-49) **Coal gasification as applied to a MHD power cycle.** Gannon, R.E.; Hals, F.A.; Ubhayakar, S.K. (Avco Everett Research Lab., MA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4978 (CONF-771203—, pp 51-52) **Synthane process: a technical and economic assessment.** Weiss, A.J. (C-E Lummus, Bloomfield, NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

4979 (CONF-780902—11) **Economics of electricity and SNG from in situ coal gasification.** Ulrich, W.C.; Edwards, M.S.; Salmon, R. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

Conceptual process designs and cost estimates are presented for two potential applications of underground coal gasification: a 900 MW(e) combined-cycle electric generating plant fueled by low-Btu gas; and a substitute natural gas (SNG) plant producing 155 MMscfd of 954 Btu/scf gas. Designs were based on experimental data obtained at the Laramie Energy Research Center on subbituminous coal using the linked vertical well in situ gasification process. Respective capital investments were estimated to be $395 and $351 million in first-quarter 1977 dollars. Product prices were calculated as a function of the debt/equity ratio, the annual earning rates on debt and equity, the cost of coal, and plant factor (onstream efficiency). Using a debt/equity ratio of 70/30, an interest rate on debt of 9%, an after-tax earning rate on equity of 15%, and a coal feed cost of $5/ton, product prices were 24 mills/kWh for electricity at 70% plant factor and $2.89/$10^6$ Btu for SNG at 90% plant factor. Calculated overall thermal efficiencies for the two facilities were 24 and 38% respectively, based on in-place coal.

4980 (CONF-7710136—, pp 46-55) **Coal gasification and its alternatives.** Huffman, R.L. (Cities Service Gas Co., Oklahoma City, OK). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The importance and need for coal gasification to the homeowner in light of the available alternatives are discussed. The status of coal gasification and announced projects are outlined citing the regulatory and financial problems which have caused unnecessary and unreasonable delays. Present energy systems are compared showing the efficiency and cost advantages of natural gas to the consumer over electricity. Energy projections stress the importance of coal and nuclear energy for the future. In this regard, utilization of U.S. coal resources for coal gasification and electric power generation are compared. These comparisons show that synthetic gas from coal is less-expensive, more-efficient, and less-capital-intensive than electricity made from the same coal for the residential consumer and point out the need for homeowners to question the legislative and regulatory dawdling going on and insist the new synthetic gas industry be supported and launched.

4981 (EPRI-AF—615) **Gasification of COED chars in a Koppers—Totzek gasifier. Final report.** Brunsvold, N.J.; Wintrell, R. (FMC Corp., Princeton, NJ (USA); Koppers Co., Inc., Pittsburgh, PA (USA)). Jul 1978. 200p. Dep. NTIS, PC A09/MF A01.

In December 1974, EPRI entered into a contract with the FMC Corporation to demonstrate COED char gasification in a commercial Koppers—Totzek gasifier. The chars were shipped to Spain in early 1975 and the gasification tests conducted at the ENFERSA plant in Puentes de Garcia Rodriguez, Spain in August 1975. The results of these tests on the two chars demonstrated that COED char could be gasified in the Koppers—Totzek gasifiers. The useful gas yield was about 45 MSCF of carbon monoxide plus hydrogen gas per ton of char. The carbon conversion of the char to gas was 85 to 90%. Some problems were encountered with the refractory lining on the plant; however, technology is claimed to be available to enable proper refractory selection for commercial life. On the basis of these results, confidence exists for the design of larger (30 tons per hour), more modern Koppers—Totzek gasifiers based on the gasification of COED char. Prior to these tests (and to other tests on the gasification of Coal Liquefaction Residues reported in EPRI Report AF-233) concern was expressed in several quarters that the residues from partial coal conversion processes, such as pyrolysis or coal liquefaction, might be too inactive to enable their conversion to gas in gasification processes. The results of the tests reported here and in AF-233 show that such residues can be converted to synthesis gas at reasonable oxygen consumptions and carbon conversions. Although the development of pyrolysis processes is still being pursued, they do not appear to be as attractive for most potential applications in the power industry as complete conversion processes for reasons which are given.

4982 (FE—2006-10) **Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, October—December 1977.** Wiser, W.H. (Utah Univ., Salt Lake City (USA). Dept. of Mining and Fuels Engineering). May 1978. Contract EX-76-C-01-2006. 89p. Dep. NTIS, PC A05/MF A01.

Diffusion rates of polyaromatic compounds in alumina catalyst supports at room temperature were appreciably faster than predicted based on the pore diffusion theory. This has been ascribed to a surface diffusion component, which contributes about two-thirds of the diffusion flux and may be independent of the size of the aromatic compound. The reaction rate of coal particles in a coiled

tube hydrogenation reactor was linearly dependent on the external surface area of the particles. Ultimate conversion to liquid and gaseous products was independent of the particle size. Structural analysis of the acidic and basic fraction of the heavy oil produced by catalytic hydrogenation of coal has been completed. The average molecular weight of the acid fraction was 246 while that of the base fraction was 279. Subfractions of the acid fraction obtained by gel permeation and elution chromatography had molecular weights ranging from 229 to 986, while base subfractions ranged from 237 to 455. The fraction of aromatic carbons ranged from 0.43 to 0.86, with 1 to 3 rings per average molecule.

4983 (FE—2240-31(App.2)) **Factored estimates for eastern coal commercial concepts. Technical appendix II: engineered equipment descriptions. Interim report. Series No. IV: B-2.** Detman, R. (Braun (C.F.) and Co., Alhambra, CA (USA)). Sep 1978. Contract EX-76-C-01-2240. 435p. Dep. NTIS, PC A19/MF A01.

Evaluation contractor for joint DOE-GRI Coal Gasification Program. Portions of document are illegible.

4984 (FE—2355-2(Rev.F)) **Coal gasification valves: Phase II. Quarterly technical progress report, December 1977—February 1978.** Harper, C. (Consolidated Controls Corp., El Segundo, CA (USA)). Apr 1978. Contract EX-76-C-01-2355. 33p. Dep. NTIS, PC A03/MF A01.

Hardware fabrication, hardware fabrication problems, and hardware procurement problems are discussed. The primary goals of fabrication and assembly of the valves and development testing were impacted by the misalignment of the seal housing surfaces of the S/N 1, Type III valve, and by non-delivery of critical items for fabrication of the Type I, II, and IV valves. Substantial progress was made toward fabrication of the S/N 2, Type III valve.

4985 (FE—2369-23) **Exxon catalytic coal gasification process predevelopment program. Monthly report, December, 1977.** Nahas, N.C. (Exxon Research and Engineering Co., Baytown, TX (USA)). 26 May 1978. Contract EX-76-C-01-2369. 20p. Dep. NTIS, PC A02/MF A01.

Solids analyses for all FBG yield periods have been completed. The off-line material balance computer program has been used to reconcile the data from 11 of the 18 FBG yield periods. Bench scale fixed bed gasification studies indicated that KOH is equivalent to K_2CO_3 as a gasification catalyst. However, K_2S shows lower catalytic activity than K_2CO_3. Also, Wyodak coal catalyzed with either KOH or K_2CO_3 shows the same reactivity as Illinois coal impregnated with these catalysts. Work continued on the Catalytic Coal Gasification Commercial Plant Study Design. Process bases and heat and material balances have been completed. Current efforts are directed toward calculation of investment, operating and product gas costs. A screening study was made of alternative methods of producing makeup KOH by electrolysis of KCl. This study showed that KOH could be produced in diaphragm cells or membrane cells at significantly lower cost than the current price of purchased KOH. Another screening study showed that the cost of potassium recovered by calcium hydroxide digestion is about 68% of the cost of purchased KOH. Further work will be required to better define the relative costs of recovered vs. manufactured KOH. Studies to evaluate alternative acid gas removal processes were completed. An evaluation of conventional acid gas scrubbing techniques indicated that selective heavy glycol scrubbing is the preferred process for a catalytic gasification plant, closely followed by non-selective hot potassium carbonate scrubbing. An evaluation of cryogenic fractionation for acid gas removal showed that this technique cannot be carried out without CO_2 freezing out in the fractionator.

4986 (FE—2710-2) **Instrumental analysis of sulfur compounds in coal process streams. Quarterly technical progress report, January—March 1978.** Jordan, J. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Apr 1978. Contract EF-77-S-01-2710. 33p. Dep. NTIS, PC A03/MF A01.

Tridimensional plots were generated delineating the abundance profiles of the moieties H_2S(aq), HS^-, S/sup =/, S(s, orthorhombic), HSO_4^- and SO_4/sup =/ as function of pH and redox potentials, encompassing all temperatures within the stability domain of liquid water at a pressure of one atmosphere. The development of optimum voltammetric procedures was expanded by the electroanalytical study of an organic sulfur compound known to occur as a contaminant in synthoil process streams. Cyclic voltammograms of dibenzothiophene (DBT) were obtained at a stationary glassy carbon indicator electrode, yielding a well-defined peak which corresponded to the electrooxidation of DBT to the 9-[3-dibenzothiophenyl]-dibenzothiophenium ion. Work was continued on the quantitative analysis of SO_2 by differential pulse voltammetry. It was ascertained that the following common contaminants of coal conversion process streams did not interfere: phenol, thiocyanate, ammonia, chloride and sulfate. Enthalpimetric methods development was advanced by laying the foundations for a new approach to the analysis of mixtures of several sulfur compounds. The crux of the method is differentiation by the heats of reaction with a series of common reagents which are non-specific per se, but react engendering non-identical enthalpy changes with different sulfur moieties.

4987 (HCP/T2027—01/A) **Materials—process—product analysis of coal process technology. Volume 1A. Appendix annex to Volume I: MPPM algorithms and other data. Final report for Project Phase II.** Roig, R.W. (International Research and Technology Corp., McLean, VA (USA)). Sep 1978. Contract EX-76-C-01-2027. 176p. Dep. NTIS, PC A09/MF A01.

4988 (HCP/T2027—02) **Materials—process—product analysis of coal process technology. Volume II. Part 1: process data. Final report for Project Phase II.** Roig, R.W. (International Research and Technology Corp., McLean, VA (USA)). Sep 1978. Contract EX-76-C-01-2027. 355p. Dep. NTIS, PC A16/MF A01.

Portions of document are illegible.

4989 (HCP/T2027—05) **Materials process product analysis of coal process technology. Volume III. User's guide to the MPPM. Final report for Project Phase II.** Roig, R.W. (International Research and Technology Corp., McLean, VA (USA)). Sep 1978. Contract EX-76-C-01-2027. 234p. Dep. NTIS, PC A11/MF A01.

4990 (LLL/TB—005) **LLL energy technologies.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1978. Contract W-7405-ENG-48. 53p. Dep. NTIS, PC A04/MF A01.

Lawrence Livermore Laboratory (LLL) research programs directed toward recovering and conserving major energy resources are outlined. The research programs are based on the following concepts: (1) Underground Coal Gasification; thick coal beds can be converted underground into a mixture of combustible gases suitable for use as a fuel. (2) Underground Oil Shale Retorting; when oil shale is heated underground to about 400°C, organic material bound in the rock structure decomposes, forming shale oil, a petroleum-like liquid. (3) Gas Stimulation by Massive Hydraulic Fracturing; by fracturing tight underground gas shales and sandstones, great quantities of natural gas can be liberated that would otherwise remain trapped in the rock. (4) Solar Energy; unique solar heat collectors developed at LLL can provide industry with large quantities of hot water and steam at competitive costs. (5) Uranium Resource Survey; LLL is participating in a comprehensive National Uranium Resource Evaluation (NURE). (6) Metal-Air Power Cells for Automobiles; metal-air power cells seem capable of matching the range and performance of internal combustion engines. (7) Fiber-Composite Flywheels for Energy Storage; flywheels made of light, strong, fiber-composite materials could improve the performance of electric cars.

4991 (MIT—2295T9-8) **Computer-aided industrial process design. The Aspen Project: seventh quarterly progress report, 1 December 1977—28 February 1978.** (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 15 Mar 1978. Contract EX-76-C-01-2295-009. 136p. Dep. NTIS, PC A07/MF A01.

The design of ASPEN system architecture was completed. Information flow through the system was analyzed and structure charts prepared showing the interconnection of modules in the system. ASPEN will utilize a precompiler type approach. The format of the main calling program and the interface with various phases of calculation were determined. The basic structures of the data in-core as well as data stored in files were designed. FORTRAN was chosen as the programming language for the executive. The ASPEN input language will be free format, consist of commands and keywords and have enough structure so that a user can easily input and understand the problem. Wherever possible, default values will be provided for missing data and data will be checked for upper and lower bounds. Design of data structure for the computational procedures was completed. The user will be able to insert FORTRAN statements and add FORTRAN programs. The stream structure for ASPEN was defined. The data structure for streams accommodate multiple liquid and solid phases. It will be able to represent components not characterized by pure chemical compounds or pseudocompounds and accommodate non-conventional attributes such as particle size distribution for a solid phase. The data constituting the block data list for UOS model computation has been defined and is described. Program subsystems are reported briefly: Physical properties, data bank, unit operations, cost estimation, economic evaluation, data regression, and proprietary software acquisition and modification.

4992 (ORNL—5421) **Fossil Energy Program. Quarterly progress report for the period ending March 31, 1978.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 237p. Dep. NTIS, PC A11/MF A01.

The large commercial coal conversion plants are predicted to involve thick section construction of ferritic steels up to the 250- to 350-mm range (10 to 14 in.). The microstructures and properties resulting from cooling rates at the centers of thick sections are being

experimentally simulated to determine whether the properties will be adequate. Data for 2¼ Cr—1 Mo steel, a leading candidate alloy, are presented. Suitable welding guidelines for depositing type 320 Cb stainless steel on 2¼ Cr—1 Mo steel and on plain carbon steel by these methods are being explored. Results of environmental and health studies related to various fossil energy processes are described. In particular, progress is reported on the development and validation of several analytical and testing techniques employed to identify biologically active constituents, on the co-mutagenic properties of several polyaromatic hydrocarbons, on the transport, transformation, and toxicity of various organic and inorganic materials in either aquatic or terrestrial systems, and on the removal of coal conversion products from aqueous effluents by sorption, ozonation, biological treatment. A program aimed at developing a process for separating pyritic sulfur and other inorganic constituents from dry pulverized coal was begun in 1977. Initial work has concentrated on defining the magnetic separability of several Eastern coals and on demonstrating technical feasibility of a batch high-gradient magnetic separator/fluidized bed system. The separability studies demonstrated close agreement between magnetic separability and the conventional float sink separability for the coals tested. Investigations of methods for processing fly ash have led to the development of two new processes, Calsinter and $NaCl/Na_2Co_3$ sinter leach, capable of recovering >90% of the aluminum present in fly ash.

4993 (ORNL/TM—6454) **Fossil energy program. Progress report, May 1978.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Jun 1978. Contract W-7405-ENG-26. 67p. Dep. NTIS, PC A04/MF A01.

Results are reported from hydrocarbonization of Illinois No. 6 coal in the bench-scale reactor. All heat treatment for as-quenched, quenched and tempered, and stress relieved samples of 2-¼ Cr-1 Mo steel is complete and some aging is in progress. Impact testing of material that was slow-cooled (0.3 K/sec) from 1038°C and subsequently heat treated has been completed. Work is underway on COGAS process residues and attempts are underway to secure representative SRC wastes. The Environmental Monitoring Handbook was completed. Technical assistance was provided to DOE/FE on four demonstration plants: Grace/Ebasco; Memphis Light, Gas and Water; ICGG; and CONOCO Work was initiated on the atmospheric fluidized bed combustion assessment. In process modeling the revised physical properties package was received from Purdue and has been compiled and linked into the subroutine library. Evaluation of market demand for coal conversion equipment is continuing. Process flowsheets were completed for all major plant units of the in situ syngas-to-gasoline facility. Material and heat balances for the M-gasoline plant were revised. In hygas modeling work continues on the areas of devolatilization, the characterization and thermal cracking behavior of coal derived liquids, model definition and thermal cracking behavior, model definition and development of a multiple bed simulation program. Information for the H-Coal process has been collected. Fixed capital cost estimates and profitability analyses for the SRC-II, CSF, and H-Coal processes are in progress. Monitoring of the HYGAS Pilot Plant continues.

4994 (ORNL/TM—6518) **Fossile Energy Program. Progress report, July 1978.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 64p. Dep. NTIS, PC A04/MF A01.

In preparation for the final bench-scale hydrocarbonization experiment, HC-28, the ambient mock-up has been operated with the draft tube directly coupled to the cyclone inlet. Char recirculation rates to 600 lb/hr (40 lb/ft^2·sec) have been achieved with single stage cyclone efficiency of 99.7%. Testing of tempered, stress-relieved, and aged 2¼ Cr—1 Mo steel cooled at 3K/sec and 0.3K/sec has been completed, and data are being analyzed. Examination of heat exchanger tubes exposed in the FluiDyne AFBC is continuing. An additional 1000-hr test period has been completed and four tubes have been removed for complete examination. Flow sheets were prepared for portions of the 5 ton/hour coal feeder test facility and descriptions of the seven subsystems were completed. Both volumes of the (second) draft report Low Btu Coal Gasification Processes were revised to include recent comments. Publication of the report will now proceed. Material and energy balances for the M-gasoline facility have been completed. Final adjustments to capital and operating costs will proceed upon receipt of information to be supplied by Davy Powergas, Inc. In the fossil energy environmental project work is under way on COGAS process residues using the smaller lysimeters and attempts are under way to secure representative SRC wastes. Coal lysimeters are about ready for installation and field-scale testing. Technical assistance was provided to DOE/FE on three demonstration plants: Grace/Ebasco; Memphis Light, Gas and Water; and ICGG. Work continued on the atmospheric fluidized bed combustion assessment.

4995 (SAND—78-0941) **Proceedings of the 4th underground coal conversion symposium.** (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 301p. (CONF-780723—). Dep. NTIS, PC A14/MF A01.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

The 4th Underground Coal Conversion Symposium was held at Steamboat Springs, Colorado, July 17 to 20, 1978. It was sponsored by the U.S. Department of Energy's Division of Oil, Gas, Shale, and In-Situ Technology and cohosted by Sandia Laboratories and the Denver projects office, US DOE. Thirty-nine papers have been entered individually into EDB and ERA; 5 papers had been entered previously from other sources. The papers involve research programs and on-going in-situ projects of US DOE, instrumentation and process control, economics, feasibility studies, oxygen supplies, ground subsidence, regulations, chemical reactions and chemical reaction kinetics, pyrolysis of coal, permeability of coal, etc. A few papers involve Canadian efforts in this area. (LTN)

4996 (SAND—78-0941, pp 5-18) **Department of Energy's 1978 underground coal conversion program.** Burwell, E.L.; Sikri, A.P.; Zukor, S.H. (Dept. of Energy, Washington, DC). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

The DOE program, as currently structured, is described. It again reflects a redirection of the program. This is expected of a young, emerging technology and it will probably continue to change as data becomes available, industry reassesses its position and needs, and program funding levels are adjusted. The program's highest current priority is the development of all necessary input data for the Hanna 5 burn in order to reach the point of commercial decision of the low-Btu gas concept being directed by LERC as soon as possible. LLL's success with steam-oxygen in FY 78, along with the many advantages of production of medium-Btu gas, may allow commercialization of the technology in the same time frame as that for low-Btu gas. MERC has produced a new concept for gasification of Eastern bituminous coals that warrants full investigation. Development of the SDB technology through Government-industry cost sharing is proceeding on schedule. Industry attention to UCG is growing rapidly, ensuring rapid technology transfer and may result in cost sharing of more of the planned research. The synergistic interaction between the different UCG project teams is resulting in much more rapid advancement of the technology development than would occur through separate programs and allows efficient and cost effective utilization of program funds, resources, and personnel.

4997 (SAND—78-0941, pp 41-49) **Status report on the Hanna III and Hanna IV underground coal gasification experiments.** Bartke, T.C.; Dockter, L.; Sterner, T.E.; Virgona, J.E.; Wojdac, L.F. (Laramie Energy Technology Center, WY). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

The third and fourth in a series of underground coal gasification experiments at a site near Hanna, Wyoming, are currently underway. This paper describes the process conditions and includes some pertinent information for these experiments. Approximately 2800 tons (2540 tonnes) of coal were gasified on Hanna III during a 38-day gasification period with production rates of up to 10 MM scf/day (268 km^3/day) of 138 Btu/scf (5.4 MJ/m^3) product gas. Groundwater sampling and analyses to determine the potential impacts of underground coal gasification on groundwater quality are ongoing. The Hanna IV experiment is significantly larger than previous experiments. It consists of a 3-well pattern, in line, with 100-foot and 150-foot spacings. Insufficient site characterization and severe technical problems have jeopardized several of the original objectives of the Hanna IV experiment. Inability to correct an override situation across the 100-foot well spacing resulted in a premature shutdown. Preparations are being made to continue the experiment and recover from the override situation.

4998 (SAND—78-0941, pp 51-63) **MERC program for in situ gasification of eastern coals.** Strickland, L.D.; Martin, J.W.; Liberatore, A.J.; Gillmore, D.W. (Morgantown Energy Research Center, WV). Jun 1978.

In Proceedings of the 4th underground coal conversion symposium.

The status of the program of the Morgantown Energy Research Center, Department of Energy, to develop underground coal gasification in the East is reviewed. The MERC program is undergoing changes in scope and direction due to increased emphasis on field testing and on evaluating alternative concepts for UCG in the East. The status of MERC's planned Linked Vertical Well minitest is reviewed. Preliminary site characterization data, site lay-outs, and test system designs are discussed. Modeling and laboratory efforts are briefly reviewed. Alternate concepts for a larger Pricetown II field test are presented and discussed. The current program plan is

then reviewed and critical milestones are noted. It is shown that the major tasks of reorientation for the eastern program are beginning to emerge and gain momentum.

4999 (SAND—78-0941, pp 65-75) **Underground gasification for steeply dipping coal beds.** Daniel, J.H. (Gulf Research and Development Co., Pittsburgh); Alexander, P. Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

This paper describes the first industrial underground coal gasification project funded by the Department of Energy. Gulf Research and Development Company and TRW will demonstrate the Underground Coal Gasification (UCG) of a steeply dipping (>45°) bed at North Knobs near Rawlins, Wyoming. Although a number of underground gasification projects have been carried out by DOE in horizontal beds, this is the first gasification project in the United States involving steeply dipping beds (SDB). The goals of this project are: To demonstrate UCG in SDB through a joint Government/Industry cost-shared program, and to assess the economic viability of UCG in SDB. Three underground gasification exercises or "burns" of duration 20, 80, and 80 days will take place during 1980 and 1981. This paper addresses the selection and characterization of the gasification test site, the rationale and plans for the gasification tests, the instrumentation and facilities planned for the tests, and the data that each test will provide.

5000 (SAND—78-0941, pp 77-87) **Recent developments in Texas A and M University's lignite gasification project.** Strickland, R.F.; Jennings, J.W. (Texas A and M Univ., College Station, TX). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

Results of a field test of the underground gasification process have shown that a high moisture content lignite can be easily ignited. Both the field test and a mathematical model study have shown that it may be difficult if not impossible to gasify lignite seams in close proximity to water sands.

5001 (SAND—78-0941, pp 91-96) **Tennessee Colony In Situ Gasification Project: a preview.** Grant, J.F.; Haney, S.E. (Basic Resources Inc., Dallas). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

The Tennessee Colony In Situ Coal Gasification Project being conducted by Basic Resources Inc. is the most recent step in Texas Utilities Company's on-going research in the utilization of Texas lignite. The Project is a continuation of the Technological Test performed near Fairfield, Texas, to investigate the feasibility of lignite gasification in Texas. The Tennessee Colony Project will evaluate economic, technologic, and environmental feasibility of a commercial size project.

5002 (SAND—78-0941, pp 97-101) **Underground coal gasification in Canada: an assessment of the Alberta test.** Roehl, A.A.; Brown, R.A.S.; Edwards, W.C.; Jensen, E.J. (Alberta Research Council, Edmonton). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

The site of the 1976 Forestburg underground coal gasification field test was excavated during the summer of 1977. Systematic removal of material from the area affected by gasification permitted a detailed evaluation of the underground effects of the test. Measurements of overburden and coal subsidence were made for each cross-sectional cut in the coal seam and the amount of coal affected during the test was assessed by visual inspection and laboratory analysis of samples of coal, partings and overburden. Numerical data, observations and results from analyses of samples collected during the excavation were used to interpret the operational behavior of the gasification experiment and determine the process mechanics involved in the technology. Results indicate that a gas with a heating value of 5600 kJ/m^3 can be produced from a shallow, relatively thin seam. Also, linking of vertical wells with the reverse combustion method appears to be best suited to coal seams that are relatively thin or have partings to prevent the link from rising and thus reduce override of the gasification process.

5003 (SAND—78-0941, pp 103-114) **Sandia Laboratories project review: instrumentation and process control development for in situ coal gasification.** Hommert, P.J.; Northrop, D.A. (Sandia Labs., Albuquerque, NM). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

Sandia Laboratories has fielded a comprehensive instrumentation program on the Hanna IV in-situ coal gasification test. A total of 37 instrumentation wells were fielded which included downhole gas sampling canisters, thermocouples, geophones for passive acoustic measurements and two subsidence gauges. An extensive surface electrical resistivity array for remote monitoring was also fielded. Results obtained from the thermal and subsidence instrumentation are particularly emphasized in this paper. Analysis of thermal data indicated multiple reverse burn paths; one occurring at the coal seam-overburden interface. None of the paths were able to complete a link. Subsidence events showed a definite correlation with thermal events in the overburden. Thermal data tends to support the conclusion that heat loss to the overburden was the primary reason for the low gas quality. During forward gasification, burning occurred first at or near the top of the seam. Analysis of material balance and thermal data indicates a sweep width of approximately 50 feet was attained.

5004 (SAND—78-0941, pp 115-122) **Field and laboratory project to assess the technical suitability of New Mexico's deep seam San Juan coal for in situ coal gasification.** Nuttall, H.E.; Anderson, C. Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

The University of New Mexico in cooperation with the local utility, Public Service Company of New Mexico, has initiated a potential six year project to assess the technical feasibility of underground coal gasification in the San Juan Basin of New Mexico. This paper describes the initial work of characterizing the chemical, physical, and geological nature of a proposed UCG site located near the San Juan Power Generating Station in northwest New Mexico. The six year project is also discussed.

5005 (SAND—78-0941, pp 125-134) **Economic sensitivity study of UCG based on field performance, theory, and operational experience.** Boysen, J.E. (Univ. of New Mexico, Albuquerque); Gunn, R.D.; Whitman, D.L. (Laramie Energy Research Center, WY). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

This paper provides results of an economic analysis in which uncertainty has been minimized through the use of the following three types of information: Theoretical and experimental correlations of underground coal gasification (UCG) operating parameters; detailed process design based on operational experience; and sensitivity variables. Results show that the seam depth/thickness ratio is the most important variable affecting the economics of UCG. Low Btu gas from a thick coal seam at moderate depths [30-ft (9 m) seam at 600 ft (183 m)] can compete with current natural gas prices on a Btu basis even under very poor operating conditions such as high leakage and low heating value. Well spacing and gas heating value also have notable impact on the economics of UCG. The gas leakage rate and the volumetric combustion sweep efficiency affect the economic results to a lesser extent for the ranges of values considered. Future research is needed to define optimum well spacing and methods for control of the gas heating value. Research is also needed to provide information in those areas in which little or nothing is known such as gas cleanup and utilization, environmental impact and subsidence.

5006 (SAND—78-0941, pp 157-163) **Underground coal gasification for power generation in the northwest: a utility perspective.** Carlson, W.H. (Washington Public Power Supply System, Richland, WA). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

The Northwest contains several billion tons of identified coal reserves not economically recoverable by present mining techniques. Underground coal gasification offers a potentially attractive method to recover these resources for electric power generation at a price competitive with other coal-based options in the Northwest under various economic and operational assumptions. The two Department of Energy (DOE) development programs of interest in the Northwest are the steeply dipping bed and linked vertical well techniques. The present steeply dipping bed program is not a sufficient demonstration of this technology to allow transfer of the technology to the Northwest reserves, due to overburden and coal differences. An expansion of the DOE steeply dipping bed program to address these differences at a Washington test site is proposed.

5007 (SAND—78-0941, pp 165-170) **Oxygen supply to in situ coal gasification projects.** Hvizdos, L.J. (Air Products and Chemicals, Inc., Allentown, PA). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

Technical and economic factors involved in the supply of oxygen to in situ coal gasification projects are discussed. A brief review of the oxygen industry is presented. Factors affecting the cost of oxygen are discussed and relative cost factors are presented for some variables. Generalized costs are presented of oxygen supplied to commercial in situ coal gasification projects from an on-site oxygen plant.

5008 (SAND—78-0941, pp 171-176) **Cost of UCG relative to other unconventional gas sources.** Hayoz, F.P.; Cowles, J.O. (TRW Systems and Energy, McLean, VA). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

The cost of products from underground coal gasification systems is compared to other unconventional gas sources. These emerging technologies represent the future supply of gaseous fuels to supplement the dwindling domestic resource base. Two studies formed the basis for the comparison of the unconventional gas sources to underground coal gasification. These were the recently completed Market Oriented Planning Study, which analyzed the economic and market potential of the unconventional sources, and the report on the enhanced recovery of unconventional gas by Lewin and Associates. The fuel forms considered were high Btu pipeline gas, synthesis gas, and low-Btu gas for process fuel or power generation. After analyzing the results, it is shown that systems employing underground coal gasification as a source of raw gas are in general economically superior to technologies that rely on surface gasification. Underground gasification also proved to be superior to most unconventional sources of natural gas, with some exceptions from the more favorable portions of the unconventional resource base. However, underground coal gasification represents a far larger resource base that would be able to contribute significant amounts to future gas supplies. The alternative sources considered were natural gas imports, LNG imports, gas from light sands, Devonian shale, or drainage from coal deposits and geopressured methane; in addition, surface gasification of coal and biomass gasification were considered.

5009 (SAND—78-0941, pp 193-206) **Simulation studies of cavity growth during underground gasification.** Tsang, T.H.; Edgar, T.F. (Univ. of Texas, Austin). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

The prediction of cavity growth is important for selection of borehole spacing in underground coal gasification. A one-dimensional model based on chemical reaction, mass transfer, and heat transfer has been developed to predict the lateral advance of a reaction front through a coal face. Two of the important zones in a burning coal face, namely the drying and pyrolysis zones, have been analyzed in some detail, and the effects of important variables in these zones have been determined through computer studies. This model can also be expanded to three dimensions to simulate the evolution of the burned-out space in a coal seam of uniform thickness.

5010 (SAND—78-0941, pp 207-219) **Nonlinear subsidence modeling at Hoe Creek.** Greenlaw, R.C; Ganow, H.C.; Langland, R.T. (Univ. of California, Livermore). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

Finite element modeling of underground formations has been used by several researchers in attempts to calibrate models of or to predict subsidence due to in-situ coal gasification. Due to the non-linear nature of soil and rock (and material in between) it is desirable to allow for non-linear analysis. Doubtless the higher costs and limited availability of non-linear finite element analysis have forced some investigators to use linear elastic analysis of subsidence models where non-linear analysis would have been more appropriate. At Lawrence Livermore Laboratory several good computer codes are in regular use for inelastic analysis and we have taken advantage of this capability in support of the Hoe Creek gasification experiments. This paper discusses our approach to including non-linear effects in the subsidence models we have been working with. In addition we have calibrated some computer models against both field measurements and elastic theory. We have included spalling of overburden rocks in the cavity growth process and we are investigating the coupling of mechanical with thermal effects in order to predict the extent of overburden spalling.

5011 (SAND—78-0941, pp 221-229) **Role of field and laboratory data and mathematical models in reducing the uncertainty of economic studies.** Gunn, R.D.; Boysen, J.E. (Univ. of Wyoming, Laramie). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

In order to complete an economic study of UCG, a preliminary design must be made for the process. The design and economic study both require the estimation of a considerable number of variables such as depth and thickness of the coal seam, well spacing, gas heating value and production rate, air injection requirements, percentage coal recovery, thermal efficiency of the process, and rate of advance of the gasification zone. Almost never will sufficient experimental data be available to determine all variables with confidence. Furthermore, not all of the variables cited are independent of each other. The purpose of this paper is to show how mathematical models and laboratory data can lead to a major reduction in uncertainties resulting from assumptions associated with economic analyses of UCG. An economic analysis is used to illustrate this method. Mathematical model calculations are used to establish the relationships between variables such as the gas heating value and thermal efficiency. The actual correlations are developed from operating data from the Hanna field tests, but model calculations provide the theoretical explanation for the shape and sensitivity of the experimental curves. Model calculations also allow confident interpolation and extrapolation of the experimental data. The end result is an economic analysis with improved accuracy and few assumptions. Finally, it is shown how economic studies can provide valuable feedback for an ongoing research program. Certain variables have yet to be fully determined such as maximum well spacing, probable gas leakage due to subsidence and long term average gas heating value. Economic studies show which of these variables have the greatest economic impact. Those variables with maximum impact should receive the greatest emphasis in research.

5012 (SAND—78-0941, pp 231-237) **Reverse combustion along fissures in shrinking coals.** Corlett, R.C.; Shearer, D.M. (Univ. of Washington, Seattle). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

Existing reverse combustion models take no account of flow non-uniformity due to fissures, or of flow distortion as fissure geometry and permeability of proximate solid material are affected by heating and combustion. Research to model such features is motivated by the erratic behavior of reverse combustion linkage operations in subbituminous coal, which has been frequently reported but not yet rationalized. Laboratory experiments with reverse combustion in charring fuels are summarized, with emphasis on flow configuration near the maximum advance point. In subbituminous coal a moving cavity configuration has been observed, and a corresponding model framework is outlined.

5013 (SAND—78-0941, pp 259-262) **State regulation of in situ coal gasification in Wyoming.** Herlihy, D.M. (Dept. of Environmental Quality, Cheyenne, WY). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

Wyoming coal reserves probably account for approximately one-fifth of the national coal resources potentially available to in situ coal gasification. In anticipation of growing in situ recovery technology the State of Wyoming is presently drafting appropriate rules and regulations to develop environmental protection standards that would apply to in situ mining operations. A few in situ coal gasification experiments have been and continue to be operated within the state. The State of Wyoming will continue to authorize additional research and development operations so long as concomitant environmental protection research programs are implemented to assess the effectiveness of various environmental measures that would be applicable to commercial scale operations.

5014 (UCID—17918) **LLL computer system for in-situ coal gasification: Hoe Creek II.** Thorsness, C.B.; Cena, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1978. Contract W-7405-ENG-48. 215p. Dep. NTIS, PC A10/MF A01.

The Lawrence Livermore Laboratory has conducted a field test of a process to convert coal to a combustible gas, in situ. The large amount of data generated during the course of the experiment was recorded and reduced with the aid of a minicomputer based system. The system provided efficient storage, display and data

reduction capability as well as real time process information which aided in the operation and control of the experiment. In the absence of the system, real time information concerning the process would have been greatly reduced. This document describes the existing computer system used during the Hoe Creek II field test.

5015 (UCRL—13885) **Study toward the development of shaped charges in support of the University of California's Lawrence Livermore Laboratory's In-Situ Coal Gasification Program. Final report, March 1977—March 1978.** Mulcahy, M.J.; Berus, E.R. (Firestone Tire and Rubber Co., Akron, OH (USA). Defense Research and Products Div.). Jun 1978. Contract W-7405-ENG-48. 76p. Dep. NTIS, PC A05/MF A01.

The penetration of coal by shaped charge jets appears to be governed by the same systems as those expressed for penetration of jets into armor targets. A straight jet with high tip velocity accompanied by a long breakup time penetrates very well at all standoff conditions. The penetration results of this program follow the same general trend as though fired into armor or mild steel, but the basic predicting penetration-density scaling law falls far short of actual coal penetration results-by as much as 100% in some cases. Such conservative estimates calculated by the scaling law may be attributed to the rather low density of the coal (1.31 g/cc); it is also possible that some other factor may be governing penetration results, but the test firings were too few to provide sufficient data. All in all, the actual results agree with anticipated results, those being: A tandem liner is superior to a standard liner of the same type at all standoff conditions; a low density liner material, aluminum in this case, does indeed open up a larger target hole diameter, but not to the extent anticipated; and a lead-tin liner will perform as well as a copper liner, and has the advantage of producing no slug to plug the target hole.

5016 (UCRL—81382) **Underground gasification of Rocky Mountain coal.** Stephens, D.R.; Hill, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jul 1978. Contract W-7405-ENG-48. 24p. (CONF-7805116—1). Dep. NTIS, PC A02/MF A01.

From Rocky Mountain coal symposium; Billings, MT, USA (10 May 1978).

Underground coal gasification offers a relatively low cost, environmentally sound method to produce clean gas from coal. The results of recent underground coal gasification tests in the U.S. have been very encouraging. A brief review of the technology is given followed by a description of Lawrence Livermore Laboratory's recent underground coal gasification experiment, Hoe Creek No. 2, in which gas of 100-150 Btu/scf was produced using air injection, and 250-300 Btu/scf when injecting steam and oxygen.

5017 Production of hot, saturated fuel gas. Kimura, S.G. (to General Electric Co.). US Patent 4,101,294. 18 Jul 1978. Filed date 15 Aug 1977. 6p.

A clean, cool stream of low Btu gas is heated and saturated with water vapor by means of a hot liquid stream containing water. Contamination of the gas stream by droplets, particulate matter and salt content of the liquid stream is obviated by maintaining separation between the gas and liquid phases by means of a microporous barrier. The barrier is made of a material selected from the group consisting of hydrophobic polymer material and hydrophilic polymer material having a gel structure.

5018 Apparatus for converting coal into gas substitutes. Sadler, J.H. US Patent 4,101,295. 18 Jul 1978. Filed date 16 Aug 1976. 8p.

Apparatus for converting coal into a gas substitute in which a slurry mix of pulverized coal and water is heated to form an emulsion which is then successively passed through a catalytic chamber and a converter chamber. The catalyzed emulsion mix is heated to destructive distillation temperatures in the convertor chamber as superheated steam is introduced into the convertor chamber to effect a continuous destructive distillation process. The products of destructive distillation are then successively scrubbed, condensed and passed through separators to separate the solids and free hydrogen from the gaseous constituents with a portion of the distillation products not comprising the final natural gas substitutes being recycled to the burner as fuel to generate the heating temperatures necessary to perform the method. The condensed water is also recycled to form the slurry or the steam introduced into the convertor.

5019 Grate for coal gasifier. Woodmansee, D.E. (to General Electric Co.). US Patent 4.098.586. 4 Jul 1978. Filed date 1 Aug 1977. 6p.

Symmetrical stepped grate/rabble arm combinations for use in a fixed bed coal gasifier are shown in which the stepped grates comprise step plates having in combination therewith means for controlling the rate of discharge of solids therefrom. The solids discharge controlling means described comprise adjustable mechanical dams at spaced locations along the step plate periphery together with means for the positioning thereof.

5020 Apparatus and method for the gasification of solid carbonaceous material. Schuhmann, R. Jr. US Patent 4,095,960. 20 Jun 1978. Filed date 9 Nov 1976. 16p.

A process and apparatus are provided for converting particulate carbonaceous fuel, such as high-sulfur bituminous coal, into a combustible gas, the process comprising forming an ignited fluidized bed of said particulate carbonaceous fuel in a closed-bottom shaft furnace, the shaft furnace having a roof enclosure, directing a jet stream of oxygen downward into the bottom zone of said ignited fluidized bed of particulate fuel by means of an oxygen lance passing axially through said roof enclosure in sealing engagement therewith, the velocity of said oxygen stream into said bottom zone being sufficient to form a dynamic highly turbulent suspension of said particulate fuel and its particulate reaction products deflecting substantially radially outwardly and upwardly and then inwardly and downwardly in a toroidally circulating manner in the bottom zone of said fluidized bed, continuously removing effluent gases formed by the reaction of said oxygen with said fluidized bed, and maintaining said fluidized bed by continually feeding makeup fuel to said shaft furnace. When the jet-fluidized bed is operated continuously below ash-fusion temperatures, said bed will accumulate and maintain a high percentage of particulate ash which is continuously withdrawn from the furnace. When the jet-fluidized bed is operated above ash-fusion temperatures and fluxes and sulfur fixation agents are fed with the coal, a molten bath is formed on the bottom of the furnace, said bath serving to collect ash, sulfides, iron, and other coal impurities in molten products which flow out of the furnace through tap holes.

5021 Treating solid fuel. Stambaugh, E.P.; Chauhan, S.P. (to Battelle Development Corp.). US Patent 4,092,125. 30 May 1978. Filed date 27 Dec 1976. 38p.

The present invention comprises a method of treating coal which permits conversion of coal to SNG under previously unobtainable conditions that allow substantial reductions to be made in plant investment and operating costs. A method of treating fine particles of solid carbonaceous fuel of the coal or coke type that comprises mixing the fuel particles with a liquid aqueous solution comprising essentially (a) sodium, potassium, or lithium hydroxide together with (b) calcium, magnesium, or barium hydroxide or carbonate, or a plurality thereof, with a ratio of (a) to the fuel of about 0.04 to 0.70 (typically 0.10 to 0.35) by weight, a ratio of (b) to the fuel of about 0.02 to 0.30 (typically 0.08 to 0.20) by weight, and a ratio of water to the fuel of about 1 to 10 (typically 2 to 5) by weight; heating the resulting mixture, at an elevated pressure, to a temperature of about 150 to 375°C (typically 175 to 300°C) in such a manner as to improve the usefulness of the fuel particles; and cooling to below about 100°C. The cooled mixture either is dried or filtered to separate the fuel particles from the solution, the particles then being washed and dried. The filtered solution is regenerated so that it can be again mixed with unreacted fuel particles. The solution typically comprises essentially sodium hydroxide and calcium hydroxide or carbonate, and may comprise also magnesium hydroxide or carbonate.

5022 Caution marks progress in coal-conversion plan. Davis, J.C. *Chem. Eng. (N.Y.);* **84**: No. 21, 77-80(10 Oct 1977).

ERDA is spending 100 million/y dollars on the demonstration programme and this could increase to 400 million dollars as the programme moves into the detailed design and construction phase. Discusses the financial and administrative problems associated with the programme, with reference to cost sharing contracts, the failure to achieve targets, selection of projects, the Coalcon fiasco and changes in managerial procedure. This is followed by a rundown of the present situation of individual projects.

5023 What's holding up coal gasification. Hirshfeld, F. *Mech. Eng.;* **99**: No. 8, 32-37(Aug 1977).

This paper reviews progress in the USA towards large scale commercial production of synthetic natural gas. Presents the advantages of producing gas rather than electricity from coal i.e., lower costs, greater efficiency and storage capability. Concludes that a solid technological groundwork has been laid for a commercial coal gasification industry and the cost of the end product appears to be competitive. Firm direction and support is now needed from Washington.

5024 Reaction kinetics of carbon and gases and the gasification of solid fuel. Fedoseev, S.D. *Khim. Tverd. Topl.;* No. 3, 94-98(May 1977). (In Russian).

Ways of increasing the efficiency of the gasification of solid fuel are discussed on the basis of both theoretical and experimental data.

5025 Conversion of coal to gas and oil: progress report No. 2. Muir, W.L.G. High Wycombe, Eng.; Muir Coal Industry Information Service (1977). 48p.

The report discusses recent developments in natural gas supply and distribution. It gives details of gasification and liquefaction; research projects; costs; and plans for industrial scale production. The Coalplex is discussed. The effect of coal characteristics on conversion is considered. A bibliography with 51 references is included.

5026 173rd national meeting of the American Chemical Society. Vol. 22, No. 1. Symposium on coal gasification kinetics. Washington, DC; American Chemical Society (1977). 216p. (CONF-770301—(Pt.2)). University Microfilms International, Ann Arbor, MI $7.00.

From 173. national meeting of the American Chemical Society; New Orleans, LA, USA (20 Mar 1977).

The 173rd National Meeting of the American Chemical Society, Division of Fuel Chemistry was held at New Orleans, LA, March 21—25, 1977. Papers presented at the "Symposium on Coal Gasification Kinetics" and the "Symposium on Gasification of Coal to Produce Low Btu Gas" were published as Vol. 22, No. 1, (preprints). Eighteen papers presented have been entered individually into EDB and ERA. (LTN)

5027 Reactivities of heat-treated coals in steam. Linares, A.; Mahajan, O.P.; Walker, P.L. Jr. (Pennsylvania State Univ., University Park). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 1, 1-3(1977). (CONF-770301—P2).

From 173. national meeting of the American Chemical Society; New Orleans, LA, USA (20 Mar 1977).

We have previously reported reactivities of various American coal chars in air, CO_2, and H_2. In this paper, we are presenting reactivities of the same set of chars in steam. Reactivities have been measured at 910°C in one atmosphere of N_2—H_2O mixture containing water vapor at a partial pressure of 17.5 torr. The variables chosen for investigation were rank of parent coals, mineral matter content, particle size, reaction temperature and pressure. Effect of addition of H_2 to steam on char reactivity has also been studied. Reactivity parameters for various chars along with relevant analyses of coals and chars are listed. It is seen that char reactivity decreases, in general, with increase in rank of the parent coal. There is a considerable spread in reactivities of chars produced from coals of different rank. Removal of mineral matter decreases, in general, subsequent char reactivity. However, in the case of chars derived from higher rank coals mineral matter removal enhances reactivity. Removal of mineral matter from coals prior to their carbonization brings about profound changes in surface area and porosity. The decrease in char reactivity and changes in surface area are much less pronounced when the chars rather than the coal precursors are demineralized.

5028 Catalysis of char gasification by minerals. Tomita, A.; Mahajan, O.P.; Walker, P.L. Jr. (Pennsylvania State Univ., University Park). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 1, 4-6(1977). (CONF-770301—P2).

From 173. national meeting of the American Chemical Society; New Orleans, LA, USA (20 Mar 1977).

It is well known that most minerals act more or less to catalyze carbon gasification. Because of current interest in coal gasification, it is desirable to know the extent to which inorganic impurities in chars (as a result of being present in the original coals) increases gasification rates. The aim of the present study is to investigate possible catalytic activity of major minerals found in coals for char gasification in air, CO_2, and H_2. Since coals and, hence, chars are invariably associated with many inorganic impurities, a high purity polymer char having a structure similar to coal-derived chars has been used in the study. The high purity char was obtained by carbonizing Saran in the manner described previously. The following minerals were used: kaolinite, illite, calcite, dolomite, gypsum, quartz, rutile, pyrite and siderite. Reactivity parameters for various char-mineral mixtures in air, CO_2 and H_2 are listed. The results indicate little or no catalytic effect of the minerals studied on char reactivity in air. Pyrite, gypsum, kaolinite and calcite inhibit the reaction in CO_2; the effect is most pronounced for pyrite. Although both C—CO_2 and C—O_2 gasification reactions involve an intermediate oxygen transfer step, the aforementioned minerals inhibit the reaction in CO_2 whereas they have no such effect in O_2. This shows high catalytic specificity for gasification reactions in different oxidizing atmospheres. Most of the minerals have an effect, either catalytic or inhibitive, on the hydrogasification reaction. Siderite and pyrite show large catalytic activity. Both these minerals contain iron as a major component and it is well known that metallic iron catalyzes the C—H_2 reaction. Illite, gypsum, rutile, kaolinite and calcite have an inhibitive effect on the hydrogasification reaction. The inhibitive effect is most pronounced for calcite.

5029 Unification of coal char gasification reactions. Walker, P.L. Jr.; Mahajan, O.P.; Yarzab, R. (Pennsylvania State Univ., University Park). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 1, 7-11(1977). (CONF-770301—P2).

From 173. national meeting of the American Chemical Society; New Orleans, LA, USA (20 Mar 1977).

The reactions of oxygen, carbon dioxide, steam and hydrogen on coal chars produced from a complete spectrum of American coals from anthracite to lignite were studied. For each reaction a major increase in char reactivity with decreasing rank of the coal from which the char is produced was found. Such increase has been explained to be consistent with the three important parameters which control gasification rates of microporous chars. That is, as chars are produced from coals of decreasing rank under fixed conditions of charring, the concentration of carbon sites active to gasification increases, the accessibility of reactant gases to these active sites increases, and the specific activity of inorganic impurities towards catalysis of gasification increases. It was noted that even though there were major differences in char reactivity as the rank of the parent coal from which chars were produced was changed, the shape of the burn-off versus reaction time plots appeared to be quite similar. If this is so, all reactivity plots should be able to be normalized using an adjustable time parameter, tau, which can conveniently be used as a measure of differences in reactivity for a wide spectrum of chars. This paper concerns itself with examining the feasibility of such a normalizing procedure. It was found that individual reactivity plots can be well normalized using a dimensionless time scale such that $t/tau_{0.5}$ equals one at a fractional burn-off of 0.5. An equation involving first, second, and third power terms in $t/tau_{0.5}$ gave the best correlation of the data.

5030 Reactivity of coal chars with CO_2 at 1100-1600°C. Yang, R.T.; Steinberg, M. (Brookhaven National Lab., Upton, NY). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 1, 12-16(1977). (CONF-770301—P2).

From 173. national meeting of the American Chemical Society; New Orleans, LA, USA (20 Mar 1977).

Knowledge of the coal char reactivity in the temperature range 1100 to 1600°C is of fundamental importance in understanding many coal gasification and direct combustion processes. Recently, a diffusion cell technique has been developed at Brookhaven for measuring the chemical rates in the diffusion/chemical reaction combined-controlled region and the technique has been applied to studies of the kinetics of the reactions between CO_2 and a nuclear graphite in the temperature range of 1200—1600°C. In this paper the initial results of the kinetics of the same reaction at a total pressure of 1 atm using coal chars of varying rank are reported.

5031 Kinetics of initial coal hydrogasification stages. Johnson, J.L. (Inst. of Gas Tech., Chicago). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 1, 17-37(1977). (CONF-770301—P2).

From 173. national meeting of the American Chemical Society; New Orleans, LA, USA (20 Mar 1977).

The results obtained in this study indicate that the initial gasification of low-rank coals in hydrogen-containing gases at elevated pressures occurs in two stages. The first stage involves thermally activated devolatilization reactions resulting in the evolution of carbon oxides, water, oil and tar, and some light gaseous hydrocarbons, and leading to the formation of an intermediate semi-char. The second stage occurs consecutive to primary devolatilization and involves thermally activated decomposition reactions associated with the secondary devolatilization of remaining coal hydrogen, leading to the formation of a relatively nonreactive char. Significantly, yields of methane-plus-ethane, other than that derived from thermal coal-decomposition reactions or from C_3^+ light hydrocarbon hydrogenation reactions, are stoichiometrically related to coal hydrogen evolved during the secondary devolatilization stage. This has suggested a model in which the transitions that occur in conversion of semi-char to char, with associated coal hydrogen evolution, involve the formation of a reactive intermediate carbon structure that can either rapidly react with gaseous hydrogen to form methane and ethane or can convert to nonreactive char. The ratio of methane-plus-ethane formation to char formation is independent of temperature but is directly proportional to hydrogen partial pressure. A numerical representation of this model permits detailed prediction of the kinetics of methane-plus-ethane formation for practical application to reactor design for systems using low-rank coals. A strong possibility that this model might also be suitable for application to gasification of high-volatile bituminous coal was also suggested, based on analyses of some available data obtained in other investigations.

5032 Novel approach to gasification of coal using chemically incorporated catalysts. Chauhan, S.P. (Battelle Columbus Labs., OH); Feldmann, H.F.; Stambaugh, E.P.; Oxley, J.H.; Woodcock, K.; Witmer, F. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 1, 38-52(1977). (CONF-770301—P2).

From 173. national meeting of the American Chemical Society; New Orleans, LA, USA (20 Mar 1977).

The data on the Battelle treatment of coal with CaO in the presence of NaOH shows that nonagglomerating BTC having a very high (hydro)gasification reactivity compared to raw coal can be produced from raw coal particles as large as 20 mesh. The maximum-possible hydrogasification reactivity of BTC is independent of raw coal particle size. But, -20 +28 mesh coal requires about twice as long a treatment time as 70 percent minus 200 mesh coal to achieve the maximum-possible reactivity. The increase in the reactivity of coal due to treatment is accompanied by a decrease in the tendency for agglomeration during hydrogasification. And, at the treatment time required to achieve maximum reactivity, the agglomeration tendency is completely eliminated. The FSI of coal particles as large as 0.25 inch from Pittsburgh No. 8 seam is found to be reduced from 8 to 0 due to Battelle treatment. It has been established that the BTC produced in a continuous treatment plant has the same (hydro)gasification properties as BTC produced in a batch reactor. Comparison of (hydro)gasification properties of BTC and preoxidized coal from the Synthane Process shows that (a) (hydro)gasification reactivity of BTC is much higher, (b) (hydro)gasification of BTC yields substantially greater quantities of C_2H_4 and C_2H_6, and (c) the equivalent CH_4 yield for BTC is significantly higher for steam gasification. The BTC also retains most of the sulfur in char, probably in the form of CaS, during (hydro)gasification. Thus, combustion of char from BTC is not expected to require an SO_2 scrubber. The above advantages of BTC over raw coal and preoxidized coal suggest that Battelle catalyst treatment should allow more reliable, environmentally-acceptable and more economic utilization of high-sulfur, Eastern U.S. coals.

5033 Gasification of a German bituminous coal with H_2O, H_2 and H_2O-H_2 mixtures. Feistel, P.P. (Bergbau-Forschung GmbH, Essen); van Heek, K.H.; Juentgen, H.; Pulsifer, A.H. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **22**: No. 1, 53-58(1977). (CONF-770301—P2).

From 173. national meeting of the American Chemical Society; New Orleans, LA, USA (20 Mar 1977).

Bergbau-Forschung has been developing a coal gasification process for a number of years. In this process heat from a high-temperature, gas-cooled nuclear reactor is used as a source of energy for the endothermic steam-carbon reaction. All of the coal is thus converted to gas which is a real advantage in countries where the cost of coal is high such as is the case in the Federal Republic of Germany. As part of the development work on this process, the reaction of several different coal samples with steam, hydrogen and steam-hydrogen mixtures has been investigated extensively in the laboratory. The objective of this work is to develop information needed to design the gasifier used to carry out steam gasification of coal, particularly when hydrogen is present in the system. The results of this investigation with one particular coal, a hard or bituminous coal, is discussed here. During the course of the investigation, samples of this coal were gasified at various steam and hydrogen partial pressures in both pure gases and in steam-hydrogen mixtures. The total system pressure was varied between 1 and 70 atm and runs were conducted over a range of temperatures from 600 to 1100°C. The rate of gasification of a bituminous coal sample in steam, hydrogen and steam-hydrogen mixtures has been measured and rates correlated by assuming that the base carbon conversion rate was proportional to the amount of base carbon present. Expressions were then found to describe the effects of temperature and steam and hydrogen partial pressures on the rate constants for the steam-carbon and hydrogen-carbon reactions.

5034 Technology and economics of coal gasification. Papic, M.M. *Can. J. Chem. Eng.;* **43**: No. 5, 413-420(Oct 1976).

Coal Gasification processes, which use oxygen (air) and steam as gasifying media are discussed, including the advantages and limitations of fixed bed processes (one- and two-stage gas producers and the Lurgi gasifier), fluidized processes (Winkler gasifier), and the entrained gasification process (Koppers-Totzek gasifier); the general characteristics of the different gasifiers including their capacities and limiting fuel properties; improvements on these processes that are under development by various companies, including underground gasification; estimated typical investment and operating costs (1975 base prices) of the various commercial coal gasification processes to produce low-, medium-, and high-caloric gases.

5035 Coal gasification: recent developments. Samanta, A.K.; Junega, M.N.; Singh, S. *Chem. Age India;* **27**: No. 10, 861-869(Oct 1976).

A review of U.S. hydrogasification processes for SNG covers the Institute of Gas Technology Hygas process; the Consolidation Coal Co.'s CO_2 Acceptor process; the U.S. Energy Research and Development Administration's Pittsburgh Energy Research Center Hydrane and Synthane process; the M. W. Kellogg Co. molten salt process [Abstract No. 22-71091]; the Bituminous Coal Research Inc. Bi-Gas process; and a comparison of the advantages and drawbacks of these processes with respect to fuel size and pretreatment, fundamental reactions, and thermal efficiency. Flow diagrams, tables, and 20 references.

5036 Lurgi Mineraloeltechnik G.m.b.H. pressure gasification of coal. Sharma, N.C. *Chem. Age India;* **27**: No. 9, 801-807(Sep 1976).

A state-of-the-art survey covers the early development (since 1930) of coal gasification processes; the changing energy market (since 1972); the production costs for ammonia and methanol from natural gas, heavy oil, or coal; the ammonia and methanol production processes; and medium-Btu gas production, including the Lurgi fixed-bed gasifier and its development, and the gasification of strongly caking and swelling coals, particularly those from the U.S. Flow charts, diagrams, tables, and photograph.

5037 Production of combustible gases. Stroud, H.J.E. (to British Gas Corp.). US Patent 3,942,957. 9 Mar 1976. vp.

To increase the Btu level of combustible gases containing both methane and hydrogen (such as those gases obtained by noncatalytic hydrogenation of oil or coal), the British Gas Corp.'s new SNG process removes the hydrogen in the catalytic hydrogenation of an unsaturated compound. The gases are admixed with an aromatic compound such as benzene (preferred), toluene, tylene, phenol, or cresol, and then subjected to a secondary hydrogenation reaction at 212° to 662°F (100° to 350°C) and 10 to 100 atm in the presence of a hydrogenation catalyst. The ratio of aromatic to gas ranges from 20 to 400 lb/1000 SCF. The benzene is regenerated by dehydrogenation, usually catalytic dehydrogenation, and recycled for further use. The hydrogen produced during dehydrogenation may be employed for hydrodesulfurization or as the hydrogenating gas in a noncatalytic hydrogenation stage.

LIQUEFACTION

REFER ALSO TO CITATION(S) 4968, 4970, 4981, 4982, 4986, 4991, 4992, 4993, 4994, 5022, 5025, 5062, 5452

5038 (CONF-771203—, pp 709-711) **COIL process: first generation commercial coal liquefaction plant.** DeVaux, G.R.; Johanson, E.S.; Chervenak, M.C. (Hydrocarbon Research, Inc., Lawrenceville, NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5039 (CONF-771203—, pp 713-715) **Effect of operating variables on SYNTHOIL reactor performance.** Derpich, T. (Univ. of Pittsburgh); Chang, S.H.; James, I.C. II. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5040 (CONF-771203—, pp 723-724) **H-Coal commercialization.** DeVaux, G.R.; Stotler, H.H. (Hydrocarbon Research, Inc., Lawrenceville, NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5041 (CONF-771203—, pp 43-44) **Economics of the H-Coal process.** Wellman, P. (Ashland Oil, Inc., KY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5042 (FE—496-T11) **Solvent refined coal (SRC) process: development of a process for producing an ashless, low-sulfur fuel from coal. Research and development report No. 53, interim report No. 20. Volume IV. Product studies. Part II. Processing of coal minerals for the period 1975—1976.** Moh, T.T.L. (Pittsburg and Midway Coal Mining Co., Shawnee Mission, KS (USA)). Apr 1978. Contract EX-76-C-01-496. 79p. Dep. NTIS, PC A05/MF A01.

The solvent refined process for coal liquefaction results in a residue, termed coal minerals, containing approximately 50% carbon and the remainder mineral material. Silica, alumina, iron, and sulfur (pyrites) make up the majority of the minerals. The gasification of the carbon as fuel and the recovery of iron and sulfur are the main concern of this study. Pulverized coal minerals from Kentucky No. 9 coal were gasified with water between 1037 and 1180°C in a batch fluidized bed reactor. The minerals were presoaked in aqueous solutions of either NaOH or Na_2CO_3 and air dried. Product gases

consisted chiefly of hydrogen, carbon monoxide, and carbon dioxide. Sulfur (from pyrites) formed hydrogen sulfide gas and the iron was reduced at the same time. A kinetic model was used to determine the rate-controlling step for the carbon-steam and iron reduction reactions.

5043 (FE—1743-49) **Zinc halide hydrocracking process for distillate fuels from coal. Annual technical progress report, February 1, 1977—January 31, 1978.** Pell, M.; Parker, W.A.; Maskew, J.T.; Zielke, C.W.; Struck, R.T. (Conoco Coal Development Co., Library, PA (USA). Research Div.). 20 Feb 1978. Contract EX-76-C-01-1743. 233p. Dep. NTIS, PC A11/MF A01.

The major efforts during the year were (1) to construct a 1 TPD Process Development Unit (PDU) for conversion of coal to distillate fuels using a molten zinc chloride catalyst and (2) to explore the effects of operating variables on a 2 lb/hr continuous bench-scale unit and develop correlations predicting conversion and product yields with Montana subbituminous coal. Construction of the PDU is 88% complete, and break-in of the liquefaction sections is underway. Correlations of conversion with residence time were developed for temperatures from 385 to 427°C (725 to 800°F), and pressures of 16.5 and 24.1 MPa (2400 and 3500 psig). Yields per ton of MAF coal were up to 4.3 bbls gasoline and 1.0 bbl of higher boiling distillate in one pass. The raw gasoline had Research Octane Numbers of 90.6 to 92.3 and low nitrogen and sulfur. Single runs showed that other subbituminous coals and bituminous coal could be successfully converted with the process. A secondary zinc recovery step was developed to increase overall zinc recovery from 98.5-99.0 to 99.5-99.6% via fluidized bed treatment of the primary coal ash with HCl-air at 1038°C (1900°F). Savings of 3.5 cents/gallon of gasoline are estimated. Work continues to improve rejection of other ash metals. Attached as Appendix A are three reports which chronicled a 1975 economic study on conversion of coal extract to gasoline. Zinc chloride processing is estimated to save 8 to 16% over ebullated-bed hydrocracking, hydrotreating and reforming to make the same product.

5044 (FE—2305-12) **Investigation of mechanisms of hydrogen transfer in coal hydrogenation. Annual progress report, July 1976—June 1977.** Cronauer, D.C.; Jewell, D.M.; Kueser, K.A.; Shah, Y.T. (Gulf Research and Development Co., Pittsburgh, PA (USA)). Jul 1977. Contract EX-76-C-01-2305. 97p. Dep. NTIS, PC A05/MF A01.

Screening experiments were first undertaken to determine the relative ease of fragmenting C—C, C—N, C—O, and C—S bonds in the presence of a hydrogen-donor solvent at coal liquefaction conditions. Condensed aromatics, such as benzofuran, were stable at temperatures up to 475°C. Non-condensed aromatics, such as dibenzyl, fractured in the range of 400—475°C. Aromatic ethers, sulfides and compounds having carbonyl, alcohol and hydroxylic groups reacted readily at temperatures below 425°C. Detailed experimentation using various donors with dibenzyl indicates that the thermal reaction of dibenzyl forming benzyl radicals is controlling. The reaction rate is independent of the donor solvent (tetralin, decalin, mesitylene), but the product distribution is dependent upon the type of solvent. Hydroaromatics rearranged to form methyl indane-type compounds, thereby, resulting in a solvent of reduced hydrogen donor capacity. The study of hydrogen transfer using deuterium-tagged donor was not successful at temperatures above 400°C due to scrambling. It is anticipated that this latter experimentation will be successful at lower temperatures.

5045 (FE—2367-10) **Effects of solvent characteristics on Wyodak coal liquefaction. Quarterly technical progress report, May 1978—July 1978.** Silver, H.F.; Hurtubise, R.J. (Wyoming Univ., Laramie (USA)). 15 Aug 1978. Contract EX-76-S-01-2367. 9p. Dep. NTIS, PC A02/MF A01.

Efforts have been directed primarily to utilizing additional distillable solvents for coal liquefaction studies. Work on the identification of hydroaromatics, polycylic aromatics and alkylphenols has been continued.

5046 (SAND—78-0056) **Chemical studies of the SYNTHOIL process: catalyst deactivation.** Holloway, P.H. (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 106p. Dep. NTIS, PC A06/MF A01.

The structure, composition, and activity of new and used coal liquefaction catalyst from SYNTHOIL reactors have been determined. The structure was characterized by optical and electron microscopy, surface area, pore size distribution, and buoyancy force measurements. The lateral and in-depth composition was studied with emission spectroscopy, electron microprobe, Rutherford backscattering, x-ray photoelectron, and Auger electron analyses. Catalytic activity was measured with product quality data and model compounds in a pulsed microflow reactor. These data show that one primary and three secondary deactivation mechanisms are operative in short term SYNTHOIL reactors. Coking is the dominant mechanism and significant coke deposition occurs very early in the SYNTHOIL process. Of the three secondary deactivation mechanisms, deposition of coke and coal minerals on the surface is the most obvious. However, no evidence was obtained to indicate that these crusts caused significant activity loss in these short-term experiments. Another mechanism is Fe and Ti penetration of the catalyst pellets, but again no activity loss was detectable. The fourth deactivation mechanism was adsorption of nitrogen compounds. These compounds plus other heteronuclear compounds cause both irreversible and reversible activity decreases during reactor start-up. These compounds make only a second order contribution to a time-dependent loss of catalytic activity. The secondary mechanisms may be more important in longer SYNTHOIL reactor runs. Techniques to regenerate used catalysts were considered, and it was shown that removal of the coke by "burning" in air was suitable. Techniques to prevent or reduce coking were also considered, especially during reactor start-up.

5047 **Extraction of coal.** Jones, W.D.; Kimber, G.M.; McLaren, J.; Price, D.W. (to Coal Industry (Patents) Ltd.). US Patent 4,101,413. 18 Jul 1978. Priority date 8 Nov 1974, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

Coal can be extracted with high boiling aromatic oils produced by extracting the aromatic constituents of a heavy petroleum material, e.g., a bitumen residue, using a selective solvent, mixing the extract with a low-boiling aromatic solvent, adding water and separating the aromatic-containing phase and recovering said aromatic constituents. The resulting coal extract is particularly suitable for the production of electrode coke.

5048 **Separation of clays and major minerals in coal residues from coal and petroleum derived solvents.** Saad, E.T.; Rubin, D.R.; Bhattacharyya, D.; Kermode, R.I. (Univ. of Kentucky, Lexington). *Can. J. Chem. Eng.;* **56**: No. 3, 406-411(Jun 1978).

This study indicates that quantitative information on the clays present in coal would yield important information on the expected particle size in liquefaction products. In particular coals with a high fraction of kaolinite would result in very small particles which would be difficult to separate. Wollastonite which forms in the liquefaction process is readily separated almost completely with carbon dioxide as the flotation gas. With respect to the separation of clays and minerals the LCO-cresol mixture behaves similar to the coal derived SRC. H-coal oil based systems, in all cases, achieved lower separation. With CO_2 as flotation gas the separation decreased in the following order: wollastonite > calcite > quartz > illite.

5049 **Solids removal and fluid catalytic cracking of a synthetic hydrocarbon stream derived from hydrocarbon-containing solids.** White, R.J. (to Chevron Research Co.). US Patent 4,088,567. 9 May 1978. Filed date 3 Dec 1976. 8p.

A process is disclosed for the removal of solids and the fluid catalytic cracking of a synthetic hydrocarbon stream having a 90% boiling point above 800°F and containing finely divided solids. The stream is cracked under low-severity cracking conditions, and a first portion of the solids is removed along with the spent catalyst and separated from the spent catalyst in a catalyst regeneration zone. A second portion of the solids is removed by conventional means from the catalytically cracked product to form a product synthetic crude essentially free of solids.

5050 **Oxygen and oxygen functionalities in coal and coal liquids.** Ruberto, R.G.; Cronauer, D.C. (Gulf Research and Development Co., Pittsburgh). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 264-276(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Activities are reported in a program to develop an understanding of the reactions involving oxygen functional groups in coal during hydrogenative liquefaction. In the program analytical techniques for determining the various oxygen functional groups in coals have been tested and modified to measure the same groups in coal liquids produced from Belle Ayr subbituminous coal. It has been shown that carboxyl, carbonyl, and ether groups of coal are reduced during liquefaction, resulting in carbon dioxide, water, and an increase in hydroxyl oxygen.

5051 **New reactors for laboratory studies.** Berty, J.M. (Autoclave Engineers, Inc., Erie, PA). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 343-350(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Recent developments in design of laboratory and bench-scale reactors reflect mostly the developments in reaction engineering; that is the improved understanding of physical and chemical rate limiting processes, their interactions, and their effects on commercial-scale reactor performance. Whether a laboratory reactor is used to study the fundamentals of a commercial process or for pure scientific interest, it is important to know what physical or chemical

process is limiting or influencing the rate and selectivity. To clarify this, a definition is required of the regime where physical influences exist, and study the intrinsic kinetics at conditions where physical processes do not affect the rate. Reactors are illustrated whose design was influenced by the above considerations. These reactors produce results which are independent of the reactors in which they were measured, and which can be scaled up with up-to-date reaction engineering techniques.

5052 Mathematical modelling of the formation of liquid products from coal. Gagarin, S.G. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 2, 1-7(Mar 1977).

A general mathematical model has been evolved which describes the production of liquids from coal by hydrogenation in the presence of various quantities of oil products. The model is based on a regression equation which links the process parameters at the stages of hydrogenation, hydro-scrubbing and hydrocracking. Optimality criteria are formulated, and the optimum conditions are determined for maximizing the yield of boiler fuels or of motor fuels. A relationship is established between process conditions and the quantity of petroleum involved in the manufacturing process.

5053 State-of-the-art...coal liquefaction. O'Hara, J.B. *Hydrocarbon Process.;* **55**: No. 11, 221-226(Nov 1976).

From Flemish Society of Engineering large chemical plant meeting; Antwerp, Belgium (20 Oct 1976).

A review covers coal liquefaction processes, including hydroliquefaction, extraction with a hydrogen-donor solvent, pyrolysis, and indirect liquefaction (e.g., via Fischer-Tropsch and methyl fuels technology); industrial experience with coal liquefaction since 1911; current developments in the U.S., including Solvent-Refined Coal, the CSF Donor-Solvent Extraction process, and the FMC Corp.'s COED pyrolysis process; and conceptual designs sponsored by ERDA., including a hydroliquefaction plant to produce clean boiler fuels, a COED-based pyrolysis project, Fischer-Tropsch process plant designs, and a modified solvent-refined coal process designed to produce both oil and SNG.

5054 Catalytic liquefaction of coal and refining of products. Oblad, A.G. *Catal. Rev. - Sci. Eng.;* **14**: No. 1, 83-95(1976).

A discussion covers the history and present state-of-the-art of coal liquefaction and detailed recommendations for future investigations of coal structure and for development of catalysts in order to simplify the processes which produce liquids from coal which can be blended with crude oil and processed in existing refineries. 28 references.

PYROLYSIS AND CRACKING

REFER ALSO TO CITATION(S) 5026

5055 (EPA—600/7-77-073d, pp 39-78) **Chemical reactions in the conversion of fuel nitrogen to NO/sub x/: fuel pyrolysis studies.** Axworthy, A.E.; Dayan, V.H. (Rockwell International, Canoga Park, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

The objective of this study is to investigate the types of "preflame" reactions fuel nitrogen compounds can undergo. The inert pyrolysis study was extended to include additional coals and alternate liquid fuels. At 1100 C, the HCN yield (percent fuel nitrogen recovered as HCN) ranged from 23 to 44 percent for seven No. 6 fuel oils and from 24 to 30 percent for six coals. A COED char yielded less than 2 percent HCN, while a liquefied (catalytic) coal yielded 51 percent HCN and two hydrotreated shale oils produced 60 and 69 percent HCN, respectively. A two-stage pyrolysis reactor was developed in which volatile nitrogen compounds are evolved from fuels in the first stage and subsequently react under conditions that can be quite different. The two-stage experiments demonstrated that nearly all of the HCN forms from the secondary reactions of volatile nitrogen compounds and little forms in the initial pyrolysis process. When the first-stage temperature is decreased from 1100 to 750°C, while maintaining the second stage at 1100 C, the HCN yield from a fuel oil decreases by one-fourth. For a similar experiment with three coals and the first stage at 600 C, the HCN yields are one-third to three-fourths those obtained with both stages at 1100°C. It is postulated that more nitrogen remains in the char at the lower temperature. In addition, a study was carried out on the oxidative pyrolysis and oxidation of the model fuel nitrogen compounds pyridine and benzonitrile. The major nitrogen-containing products from both model compounds are mainly HCN and NH_3 at lower temperatures (approximately 720°C) and are N_2, N_2O, and NO at higher temperatures (approximately 760°C). With both model compounds, the maximum N_2O yield exceeds 45 percent (at about 770°C).

5056 Comparison of the rapid pyrolysis of a lignite and a bituminous coal. Suuberg, E.M.; Peters, W.A.; Howard, J.B. (Massachusetts Inst. of Tech., Cambridge). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 175-182(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

A number of differences are immediately apparent from comparison of the bituminous coal and lignite results. The lignite, with its high oxygen content should yield upon pyrolysis large quantities of oxygenated volatile products. The bituminous coal is principally characterized by hydrocarbon products, especially tar (room temperature condensibles). The tar from the pyrolysis of bituminous coal is characterized by an empirical formula $CH_{1\text{-}1}O_{0\text{-}05}N_{0\text{-}01}$, while that from the lignite has a formula $CH_{1\text{-}5}O_{0\text{-}1}N_{0\text{-}01}$. Pyrolysis of both coals does occur in several phases each of which is dominated by a single product or class of products. Four such phases are apparent for the bituminous coal: the first is low temperature (approximately 100°C) removal of surface moisture; the second, a liberation of pyrolytically formed water at peak temperatures below 400°C; the third, broad, phase occurs between 400 and 900°C during which the coal softens and hydrocarbons are evolved; above 900°C, CO and H_2 are the principal products evolved. These temperature intervals are functions of heating rate in accordance with the known behavior of activated processes; the temperature at which a particular phenomenon (or extent of reaction) is observed decreases with decreasing heating rate. In comparison with the above, pyrolysis of the lignite occurs in five phases: (1) the low temperature removal of moisture; (2) low temperature CO_2 and hydrocarbon evolution (about 450—600°C); (3) evolution of pyrolytically formed water (about 600 to 700°C); (4) evolution of hydrocarbons, hydrogen and carbon oxide (700 to 900°C); and (5) the evolution of carbon oxides (>1000°C). The fifth phase may actually involve evolution of CO_2 from carbonate minerals, rather than organic decomposition reactions.

5057 Hydrorefining of flash pyrolysis coal tar. Che, S.C.; Qader, S.A.; Knell, E.W. (Occidental Research Corp., La Verne, CA). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 307-321(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

An evaluation of the processibility of flash pyrolysis coal tar is presented. Study results show that flash pyrolysis subbituminous coal tar can be hydrorefined. Nickel-molybdenum supported on alumina was the most effective catalyst for hydrorefining among the five types of catalysts tested. The removal of asphaltenes and preasphaltenes was easy to achieve. Catalyst selection should emphasize heteroatom removal efficiency and hydrogen consumption. The catalyst life is an equally important selection criterion although this program has not completed catalyst life studies. They will be determined in the future.

SOLVENT EXTRACTION

REFER ALSO TO CITATION(S) 4963

5058 Solvent extraction of coal-derived products. Schweighardt, F.K.; Thames, B.M. (Pittsburgh Energy Research Center). *Anal. Chem.;* **50**: No. 9, 1381-1382(Aug 1978).

Procedure described should provide an analytical separation of three or four major solvent-defined solubility fractions from the multicomponent coal-derived oil. Separation is carried out below room temperature with solvents of increasing orientation solubility (polarity) parameter. One liter of solvent per fraction per 3g of starting material appears to be sufficient to define the separation. A pretreatment step has also been introduced by freezing the oil in liquid nitrogen, the resulting solid can be ground into a fine powder of great surface area, which contributes to the efficient extraction of the pentane soluble material at the onset of the procedure. Subsequent extractions include the use of benzene which dissolves asphaltenes; tetrahydrofuran or methylene chloride-methanol, which removes the preasphaltenes. The final residue is removed, washed and dried. The term preasphaltenes is used to reflect a class of solvent defined substances. The procedure has been described as having been effective in research efforts to provide reliable results of solvent separated fractions from coal-derived oils in less than 6.5 h on 3-4 g of material. One table shows weight percents of a number of coal liquefaction products ranging in viscosities from 100 to greater than 300 centistokes (70°C). Samples of this kind are also known to age under certain conditions of temperature and excess oxygen, causing changes in relative amounts. This summary has been designed as a guide for future development of a common method of separation and characterization of coal liquids. 2 tables, 1 figure.

5059 Supercritical gas extraction. Garnett, K. *S. Afr. Min. Eng. J.;* **27**: No. 12, 405-406(Dec 1977).

NCB work on supercritical extraction is described.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 6355

5060 Converting underground coal fires into commercial products. Terry, R.C. (to In Situ Technology, Inc.). US Patent 4,092,052. 30 May 1978. Filed date 18 Apr 1977. 12p.

An underground coal fire is smothered by sealing the overburden for a minimum depth over the coal deposit. Wells are drilled into the fire area and the underground reaction zone is pressurized. Using various combinations of injecting oxidizers and reducing agents the coal deposit is reduced in situ to yield a variety of useful products. Wells are cased without cement and with the hermetic seal attained by a column of slurry between the casing and well bore.

PROPERTIES

REFER ALSO TO CITATION(S) 4950, 4956, 4962, 4963, 4982, 5004, 5050, 5089, 5718, 5719, 6177, 6178, 6179, 6300, 6303, 6365, 6595

5061 (FE—2692-4) Coal minerals bibliography. Final report (quarter No. 4), June 1977—July 1978. Akers, D.J.; McMillan, B.G.; Leonard, J.W. (West Virginia Univ., Morgantown (USA). Coll. of Mining and Energy Resources). Jul 1978. Contract EF-77-S-01-2692. 8p. Dep. NTIS, PC A02/MF A01.

An extensive amount of research on the inorganic constituents in coal has been performed over a period of many years. The bulk of this work has occurred since World War II, and has increased in volume, especially for trace element studies, with the development of more sophisticated analytical equipment. Although this information is available, and of value to many people working in the coal industry, it is so widely scattered that it may be difficult to locate. Therefore, publication of the Coal Minerals Bibliography will provide a single source reference to not only assist in locating this information, but to also provide the user with insight into what information the article contains. The Coal Minerals Bibliography (FE-2692-5) was completed for submittal in draft form. The report is the culmination of one year's work to provide a comprehensive source volume of pertinent information on minerals and trace elements in North American coals. An extensive review of the technical literature was performed and annotations of more than 400 articles were written. These technical annotations and a subject index were organized and prepared in final draft form and are being submitted in conjunction with this report.

5062 (HCP/T2286—01) Coal conversion systems: technical data book. (Institute of Gas Technology, Chicago, IL (USA)). 1978. Contract EX-76-C-01-2286. 585p. Dep. NTIS, PC A25/MF A01.

The Coal Conversion Systems Technical Data Book is being developed to provide a single source of technical information necessary for the design and operation of coal conversion facilities. Such facilities include the conversion of coal to environmentally acceptable fuel forms, or to electric power by way of advanced technologies. Data books are essential aids to individuals and companies engaged in the design of process facilities. The Data Book project was initiated at the Institute of Gas Technology (IGT) in October 1974 by the Office of Coal Research and has continued under the Energy Research and Development Administration, and now the Department of Energy (DOE). The project is presently planned through 1980. In addition to being a collection of physical, chemical, thermodynamic data, and correlations, The Coal Conversion Systems Technical Data Book also outlines procedures necessary to develop a new process or to design, build, and operate a coal conversion plant. The Data Book is in looseleaf form so that it can continually be revised, expanded, and updated as technology advances. Supplemental material is constantly being prepared to keep the data in this rapidly developing energy field as up-to-date as possible.

5063 Fluorescence spectroscopy in the characterization of coal-derived liquids. Kershaw, J.R. (Fuel Research Inst. of South Africa, Pretoria). *Fuel;* **57**: 299-303(May 1978).

Fluorescence spectroscopy is a powerful analytical technique for the characterization of coal-derived liquids. Separation into fractions is necessary before meaningful data on individual ring systems can be obtained. Adsorption chromatography on silica gel is a relatively simple but, nevertheless, satisfactory separation technique, thus allowing spectrofluorometric analysis to be carried out on a routine basis. For identification of aromatic ring systems in coal liquids fluorescence spectroscopy has proved useful for the following reasons. First, emission and excitation spectra of individual ring systems may often be instrumentally resolved even though the sample contains a mixture of aromatic ring systems. Secondly, alkyl substituents, in general, appear to have only a small effect on fluorescence spectra, therefore, allowing fluorescence spectroscopy to be used for the identification of aromatic ring systems rather than individual compounds.

5064 Submicron-sized mineral component of vitrinite. Strehlow, R.A. *Fuel;* **57**: No. 3, 185-186(Mar 1978).

Mineral matter in the size range 4 to 100 nm in vitrinite from an Illinois No. 6 coal was examined with an electron microscope. The principal components were illite, kaolinite, quartz and calcium carbonate. Some of the unknown minerals contained iron and titanium. Little pyrite was observed in this size range. The size and numbers of these particles were measured, and it is concluded that the surface area of the submicron mineral matter is significantly large and may be expected to induce or promote a variety of catalytic reactions involving coal. The iron and titanium minerals may catalyse hydrogenation, while the alumino-silicates may serve as decomposition catalysts for reactions involving carbonium ions.

5065 Electrophysical characteristics as a possible basis for classifying anthracites. Lapin, A.A.; Pereverzev, G.A. *Khim. Tverd. Topl.;* No. 6, 32-37(Nov 1977). (In Russian).

Changes in the resistivity and the volt-ampere characteristics of anthracites as a function of carbon enrichment were studied. An anomalous dependence was established in terms of current density and electrical field intensity and a critical field value which was inversely related to the carbon enrichment of the sample. The methane yield can be correlated with the limiting value of the current density.

5066 Investigation of coals and the solid residues of their thermal treatment by IR spectroscopy. Kekin, N.A.; Gamazina, G.A. *Solid Fuel Chem. (USSR) (Engl. Transl.);* **11**: No. 2, 8-13(Mar 1977).

This paper describes a new method for studying the change in functional groups in coal substances as a function of temperature. The saturation band intensity is measured in infrared spectra during continuous heating of the coal.

5067 Determination of moisture coefficients of peat by centrifugal modeling. Kmitovenko, A.T.; Zelenskii, A.Ya. *Izv. Vyssh. Uchebn. Zaved., Gorn. Zh.;* No. 3, 17-22(1977). (In Russian).

A method is given for determining moisture coefficients with the aid of centrifugal modeling. For the first time the centrifugal modeling method is examined from the potential theory viewpoint on the basis of integral equality which, at the assigned time scale, has made it possible to determine values for moisture potential, moisture conductivity coefficients, and potential conductivity from the physical properties of peat. The obtained data indicate that both for peat as well as peat deposits, the transition from full moisture capacity to the arid state involves a change in moisture coefficients of several orders from 10^{-4} to 10^{-9}. 1 table, 5 references.

5068 Fixing parameters of the calibration curve of a beta backscatter ash monitor. Burek, R. *Arch. Gorn.;* **22**: No. 1, 91-99(1977). (In Polish).

The results of investigations into the effect of changes in the chemical composition of an organic substance on determination of its ash content by the beta-backscatter method are presented. A change in carbon content causes changes in backscatter which is calculated as a change in ash content unless the proper corrections are made. The same calibration curve can be ued for coals of types 32-34 from the Upper Silesian Coalfield; other types of coal require separate curves.

5069 Sulfur isotope study of Illinois Basin coals. Price, F.T. Lafayette, IN; Purdue Univ. (1977). 230p. University Microfilms Order No. 78-13,105.

Thesis (Ph. D.).

Delta S^{34} values of massive pyrite, disseminated pyrite and organic sulfur from 5 major coal seams in the southeastern part of the Illinois Basin have been determined. Disseminated pyritic and organic sulfur were chemically removed from maceral group concentrates and whole coal samples prior to isotopic analysis. Quantitative extraction of sulfur from vertical coal columns indicated that disseminated pyrite content varies greatly when compared to that of organic sulfur. Among the maceral groups, inertinite, due to its porosity and thermal history, has the highest disseminated pyrite and lowest organic sulfur content. The isotopic ratio of disseminated pyritic sulfur also exhibits large variations when compared to organic sulfur. It was found that the similarity of delta S^{34} values for organic sulfur in all 3 maceral groups renders individual analysis unnecessary. Whole coal organic sulfur and massive pyrite from the same column exhibit little local variation in delta S^{34} (generally less than 10‰) in comparison to their overall regional range (24‰ and 40‰ respectively). High sulfur coals (greater than 0.8 percent S by dry weight) are the most common and show a wide range of delta S^{34} values for organic sulfur (23‰) as opposed to low sulfur coals (‰).

5070 Mechanical properties of the Pittsburgh coal at elevated temperatures (75° to 650°F). Shoemaker, H.D. Morgantown, WV; Univ. of West Virginia (1976). 410p. University Microfilms Order No. 76-22,464.

Thesis (Ph. D.).

The properties of coal were studied in connection with U.S. Energy Research and Development Administration, Morgantown Energy Research Center coal gasification research. Temperature had a major effect on these properties, especially in the thermal softening stage (575-650°F). Coal strength increased with decreasing specimen size and increasing loading rate, and the strength of coal loaded normal to the bedding planes was about double that of coal loaded normal to the face or butt cleats. Coal swells under a constant load or deformation at 100-500°F after an initial shortening. Pittsburgh coal is non-linear viscoelastically at temperatures below the softening stage, but resembles a linear viscoelastic material as it softens and coalesces. Viscoelastically, it may be called a thermorheologically simple material. The most promising viscoelastic model studied represented coal as a six-parameter fluid.

5071 Behavior of coal ash in gasification beds of Ignifluid boilers. Harvey, R.D.; Masters, J.M.; Yerushalmi, J. Urbana, IL; Illinois State Geological Survey (1975). 26p.

Because the Ignifluid process has attracted interest in the electrical power industry and could possibly be used with Illinois coal, City College of the City University of New York procured samples from 3 commercial plants in France and Morocco to determine the petrographic properties of the ash agglomerates and the mechanism of their formation and to compare the feed coals with Illinois coals. The extraction of mineral or ash matter without loss of carbon--a major problem in coal gasification processes--is provided by the Ignifluid process. As crushed coal is gasified at 2200°-2500°F (1200°-1400°C) from an air-fluidized bed that rests on an inclined moving grate, loose ash agglomerates form and remain interspersed with the coal until they are discharged through the grate as low-carbon clinkers. The sample agglomerates were vesicular and fragmental, with quartz sand, glass, and coal char embedded in a glassy matrix containing hercynite and mullite crystallites. The size and percentage distributions of ash agglomerates in the bed appear to be functions of the rate of release of ash matter from the coke, the stickiness of the matter at bed temperature, and the eddy diffusivity of agglomerates in the bed. Ash agglomerates from the 3 plants were similar, and the mineral matter in the feed coals did not significantly differ from that found in the bituminous coals of the Illinois basin.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 4957, 4958, 4964, 5090, 5136, 5722, 5737, 6347

5072 (ANL/CEN/FE—78-8) **Effect of sodium chloride on the reaction of SO_2/O_2 mixtures with limestones and dolomites.** Shearer, J.A.; Johnson, I.; Turner, C.B. (Argonne National Lab., IL (USA)). Jun 1978. Contract W-31-109-ENG-38. 80p. Dep. NTIS, PC A05/MF A01.

A detailed investigation of the interaction of sodium chloride with limestones and dolomites during calcination and sulfation has been performed. Results show that the presence of salt induces structural rearrangements in the stones, leading to an optimum pore distribution for reaction with SO_2/O_2 mixtures. The interaction involves the presence of a liquid film that increases the ionic diffusion and mobility of the system, enhancing decarbonation, enhancing crystallization of CaO and $CaSO_4$ and creating a structure permeable to gaseous diffusion.

5073 (CONF-771203—, pp 725-726) **High intensity ionization by electron beams for coal fly ash precipitators.** Davis, R.H.; Finney, W.C. (Florida State Univ., Tallahassee). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5074 (IS-M—143) **Alumina from fly ash.** Burnet, G. (Iowa State Univ. of Science and Technology, Ames (USA)). [nd]. Contract W-7405-ENG-82. 14p. (CONF-7703106—1). Dep. NTIS, PC A02/MF A01.

From 1. B. F. Ruth chemical engineering research symposium; Ames, IA, USA (10 Mar 1977).

The results of the exploratory work done so far with the lime-sinter process show that more than 50 percent of the alumina in a typical fly ash can be made soluble by sodium carbonate extraction of the sintered product. Based on work reported for other non-bauxite materials, there is every reason to expect increased yields. Fly ash can become a potential, easily available, domestic resource for alumina. At the present rate of production of fly ash, this could supply approximately 35 percent of the alumina needs of the United States at a 50 percent recovery level. With an increase in alumina recovery to 75 to 80 percent, which appears attainable as further research leads to better processing conditions, the fly ash could supply even a greater share of the country's needs. It has been proposed that the residue from the leaching step in the lime-sinter process be dried, mixed with gypsum and calcined to produce a cement clinker. Fragmentary references in the literature suggest that this has been investigated in Hungary and Poland. If the use of the residue to manufacture cement proved technically feasible, it would mean the entire fly ash could be put to use.

5075 (ORNL—5383, pp 45-47) **Resource recovery.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

Laboratory-scale investigations were made of several methods for the recovery of Al and other metal values from fly ash and ash from coal conversion processes. (DLC)

5076 (ORNL/TM—6229) **Control of hydrocarbon and carbon monoxide emissions in the tail gases from coal gasification facilities.** Fisher, J.F.; Peterson, G.R. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 47p. Dep. NTIS, PC A03/MF A01.

A study was made of the economics of various alternative methods of controlling emissions of CO and nonmethane hydrocarbons in the tail gases from a Lurgi substitute natural gas plant. Control of sulfur emissions was excluded from the scope of the study. Processes examined for decontaminating the tail gases included recovery and recycle methods as well as those that convert the contaminants to harmless products. The most recently proposed EPA emission standards for CO and non-methane hydrocarbons were used as upper limits for the residual contaminants in the treated effluent. Limited assessments of the technical and economic feasibility of ten processes were made. Of the processes studied, the two most promising were found to be incineration in a coal-fired boiler and catalytic incineration. Neither of these methods has been employed commercially under the projected operating conditions, although both are employed in other industries to carry out the basic reactions involved. Total capital and operating costs on a 20-year discounted cash-flow basis with 100 percent equity financing and 12 percent annual after-tax return on investment were estimated to be 4 cents per 10^6 Btu of SNG for the coal-fired boiler and 5 cents per 10^6 Btu for the catalytic case. However, the uncertainties in the costs were greater than the indicated cost differentials. The cost of incineration in a gas-fired boiler using sulfur-free medium-Btu gas was estimated to be 11 cents per 10^6 Btu of SNG. All other routes examined were several times more expensive than these three methods. As a result of the economic study presented, experimental studies on catalyst-aided incineration of typical tail gases will be initiated. Moreover, an industrial assessment of the impact and consequences of high tail-gas flow on the operating characteristics and design of a commercial boiler will be pursued.

5077 Status of fabric filtration as applied to industrial coal burning. Adams, R.L. Lexington, KY; University of Kentucky (1978). 17p. (CONF-780485—7).

From Industrial coal conference; Lexington, KY, USA (26 Apr 1978).

The fabric filter is a device which will provide uniformly high efficiency with reasonable operating costs. Unlike the electrostatic precipitator and the mechanical collector, the efficiency of the fabric filter cannot be lowered in any practical way to reduce the cost of the unit. Therefore, fabric filtration is generally considered only on those installations which require high-efficiency filtration. On those installations where efficiency requirements are lower, 97% or less, the fabric filter will generally not be cost competitive. However, since air pollution codes are constantly becoming more stringent, the need for high-efficiency filtration is becoming greater every year. Thus many industrial coal-fired units that at one time needed no controls, or at the most mechanical collectors, are now required to have either high efficiency fabric filters or electrostatic precipitators. Just as there are many different types of coal-burning equipment, there are several types of fabric filters which may be applied to handle the exhaust from coal-burning operations. Each type of fabric filter has certain advantages and certain disadvantages which should be reviewed. We believe that the almost perfect on-stream reliability record of fabric filters on coal-fired boilers combined with their very economical first cost and operating costs will result in an ever increasing acceptance by industry. While there are many pros and cons with regard to the specific type of fabric filtration equipment to be chosen on a given project, all the fabric filters mentioned in this paper will provide viable means of stack gas particulate control.

5078 Application of a dry scrubber to exhaust gas clean-up. Reese, R.G. pp 55-60 of TAPPI conference papers: 1976 engineer-

ing. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The dry scrubber, a new and unique application of dry granular filtration, is used to remove particulates, in a dry form, from gas streams. Utilizing a moving bed of filtering media, the system is self-cleaning while operating on a continuous basis. The concept, development and principle of operation are discussed. A description of systems now being installed to handle up to 500,000 acfm is presented, as are test results from the operations of the dry scrubber field unit. Experience to date shows that the dry scrubber is an efficient and effective means of removing particulate from the gas stream of wood-waste-fired boilers. The design simplicity and rugged construction make it a simple and forgiving system to operate. The twenty-four hour per day, seven day per week operation of lumber, pulp and paper mills dictates a high utilization factor. The dry scrubber easily provides this with proven minimal maintenance costs.

5079 Specialty chemical treatment of paper mill boiler flue gas scrubbing systems. Murray, D.T.; Steelhammer, J.C.; Graffeo, A.J.; Terry, J.P. (Betz Labs., Trevose, PA). pp 61-69 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The development of gas cleaning technology in the paper industry has been accelerating rapidly over the past few years. With this acceleration has come a number of water related operational problems. Although the state of the water treatment art is still developing in paper mill gas cleaning applications, significant transfer of technology from other industries and data from developing paper mill systems is presented. The paper centers its attention on combustion process. Scrubber water treatment technology in coal fired boiler, bark and hogged fuel fired boiler and recovery boiler systems are discussed. Two case histories are discussed.

5080 Review of flue gas desulfurization (FGD) technology for application to coal-fired boilers in the pulp and paper industry. Lunt, R.R.; LaMantia, C.R.; Jashnani, I.L. (Arthur D. Little, Inc., Cambridge, MA). pp 191-205 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

This paper presents a review of the status of flue gas desulfurization (FGD) technology in the United States with emphasis on applicability to coal-fired, industrial-scale boilers. Systems now being commercially offered and those under active development are described and generalized, and system economics are presented. Factors affecting the selection of FGD processes or alternative means of SO_2 control are discussed, and processes that appear to be most compatible or economically practical for application to pulp and paper mill power boilers are reviewed. A number of FGD systems applicable to the control of SO_2 from pulp and paper mill boilers can be integrated with the pulp mill operation, thereby reducing overall system costs and minimizing the potential waste disposal problems, making SO_2 control a feasible, practical alternative to low sulfur coal. The choice of the most appropriate FGD system will depend on the particular mill and boiler as well as the availability of low sulfur fuels. The makeup chemicals vary from mill to mill; therefore, the ability to integrate FGD systems and pulp mill operation must be evaluated on a case-by-case basis. Based upon general system economics and flexibility, simplicity, and reliability of operation, those involving sodium solution scrubbing should be the most attractive.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 4953, 5010, 5016, 5128, 5148, 5153, 5154, 6522, 6523, 6562, 6563, 6579, 6580, 6582, 6583, 6613

5081 (ANL/AA—11(Vol.1)Draft) **National Coal Utilization Assessment. An integrated assessment of increased coal use in the Midwest: impacts and constraints.** (Argonne National Lab., IL (USA)). Oct 1977. Contract W-31-109-ENG-38. 107p. Dep. NTIS, PC A06/MF A01.

As a part of the National Coal Utilization Assessment (NCUA), two types of studies are being undertaken--(1) impacts and constraints, and (2) the solutions to these problems. A study of the conflict between air quality and coal use would consider both siting and technology options. The technology options include emerging DOE technologies for coal utilization and conversion (i.e., low-Btu gasification), add-on emission controls, variations in stack height, intermittent or supplementary control systems, and smaller unit facilities. Evaluation of siting alternatives for resolving air-quality conflicts will consider tradeoffs from increased siting in areas with: low-population areas, less sensitive ecosystems, preferable climate (e.g., reduced inversion frequency); and greater distances from PSD areas. Resolution of water shortages for future energy development in specific areas need to be investigated by using one or a combination of the following options: (1) regulation of stream flow by reservoirs: (2) development of groundwater resources; (3) reuse of waste water from municipal, industrial, or agricultural sources; (4) purchase of water rights from competing users; (5) use of less intensive wateruse technologies, e.g., dry cooling; (6) interbasin transfer; (7) alternative siting; and (8) use of advanced, more efficient technology. Local socioeconomic impacts from coal utilization result from changes in employment, population, demographic characteristics of population, and pressures for public and private services. The following options for resolving socioeconomic coal conflicts will be evaluated: rate of development; transport of coal vs. transport of conversion or combustion products; and size of the facility. In addition, financial management options for mitigating short-term growth problems will be evaluated.

5082 (ANL/AA—11(Vol.2)Draft) **National Coal Utilization Assessment. An integrated assessment of increased coal use in the Midwest: impacts and constraints.** (Argonne National Lab., IL (USA)). Oct 1977. Contract W-31-109-ENG-38. 463p. Dep. NTIS, PC A20/MF A01.

Energy supplies and energy demand are projected for the nation and the region. Siting constraints for fossil-fuel power plants and coal conversion plants are discussed. Resources of coal and water are evaluated. The environmental impacts of increased usage of coal are discussed (effects on air and water quality, effects on aquatic and terrestrial ecosystems, possible hazards of trace elements). Finally, social and economic impacts and health hazards are considered. (LTN)

5083 (ANL/IAPE/TM—78-2) **Coal related issues identified by state and regional groups in the Midwest.** Hilton, M.L. (Argonne National Lab., IL (USA)). Nov 1977. Contract W-31-109-ENG-38. 110p. Dep. NTIS, PC A06/MF A01.

Coal-related problems of general concern include increased air pollution; effects of Prevention of Significant Deterioration and other Federal air quality regulations; potential water use conflicts; acid mine drainage and other problems related to reclamation of "orphan" lands; price and availability of alternative energy sources; transportation constraints; and lack of information on new coal technologies. Perhaps the most important problem stressed was the increase in air pollution that will result from increased coal use unless advanced emission-control technologies are used. This issue is of particular importance to states in the eastern half of the region. Here the increased use of local high-sulfur coals could aid the economy of coal-producing states such as Ohio and Illinois, but would also result in higher sulfur dioxide emissions. While there is a general concern over the impacts of increased air pollution, a related problem is that of meeting Federal standards designed to control pollution. Many states are having difficulty meeting National Ambient Air Quality Standards. Conflicts over water use related to coal development are expected to increase. While both coal-fired generating plants and the gasification plants require much water, demands for municipal and industrial supply, agriculture, and recreation are also increasing. Adequate disposal of solid and liquid wastes from emission-control systems is of concern to many Midwestern state governments. Transportation problems may also slow development of coal in the Midwest. Existing rail networks, cars and engines may not be adequate to haul the amount of low sulfur coal required in the next 20 years. Several other coal-related problems were mentioned at several meetings but were not as common as those discussed above.

5084 (ANL/LRP-TM—4, pp 14p, Paper 2) **Overview of coal extraction and land reclamation programs.** Carter, R.P. Spr 1978.

In Preliminary overview of current nation-wide research activities related to surface mine land reclamation.

Estimates of the probable use of coal to secure energy U.S. self-sufficiency range from 1.2 to 1.8 billion tons per year by 1985. The bulk of this increase will probably be extracted through surface mining techniques. Surface coal production will increase in all regions, with the greatest increase in the Northern Great Plains, even exceeding that in the Eastern or Appalachian Region. Past efforts to reclaim surface-mined land in the U.S. have shown that there is at present relatively little understanding of the feasibility, costs, and potential effectiveness of alternative reclamation techniques. In view of the close relationship between the potential effectiveness of land reclamation and the feasibility of substantial development of coal resource regions, it is evident that an organized and coherent program should be undertaken to develop, test, and deploy the most cost-effective techniques and technologies for land reclamation that are currently available. Many of the relevant parameters are site- or region-specific: climatological conditions, ter-

rain, soil characteristics, microbiology, native and cultivated vegetation, surface and subsurface hydrology, and present land usage, must be considered when developing a program addressing the entire range of problems. The program will therefore develop field research teams and a laboratory facility to: Conduct coordinated research and development programs focused on near- and long-term land reclamation problems in the four major U.S. coal resource regions; and to coordinate, evaluate, and disseminate the results of related studies conducted at other research institutions. One of the key objectives of this program will be to provide decision-makers, industry, and independent research organizations with reasonable available options and their costs.

5085 (ANL/LRP-TM—4, pp 5p, Paper 3) **Automatic data processing system for surface mining in Tennessee.** Zurawski, R.P.; Wilson, J.M. Spr 1978.

In Preliminary overview of current nation-wide research activities related to surface mine land reclamation.

In the past Tennessee surface mining information has been collected or used by at least ten different state agencies. Much information was duplicated and little data sharing occurred among the agencies. This paper discusses the computer program developed by the Tennessee Division of Geology and the Tennessee State Planning Office to place information common to the agencies in one central location. The development and operation of the program is discussed, and the method by which data will be shared is outlined.

5086 (ANL/LRP-TM—4) **Preliminary overview of current nation-wide research activities related to surface mine land reclamation.** (Argonne National Lab., IL (USA)). Spr 1976. Contract W-31-109-ENG-38. 33p. Dep. NTIS, PC A03/MF A01.

A total of five federal agencies and departments are funding reclamation research associated with understanding the environmental and socio-economic impacts of the surface mining of coal. Each organization, depending upon its preconceived mission, approaches the funding from a slightly different direction. While much of the current reclamation research is addressing interesting and real site-specific problems, almost all of it has been initiated without a comprehensive national research plan. Duplication and overlap, disorganization, aggravation, and poor coordination are common faults. There is a strong belief that no one in the government is cognizant of the total reclamation research effort. There does not exist a clear statement of the problems in a regional or national context. It is impossible even to obtain a good estimate regarding the amount of land disturbed each year by surface coal mining. Also, extraction practices of uranium, oil shale, and other mineral mining require closer scrutiny to determine the research efforts required to minimize environmental, health and socio-economic impacts. There is a need to develop a coherent national program that can begin to piece together the patchwork efforts currently underway and identify the information needed to plan and implement a national land reclamation program that can assess the environmental impacts of coal development and provide cost-effective techniques for reclaiming and rehabilitating mined land to productive end use. Much of the past and current research information has not been transferred from the researcher to the user. Therefore, in many instances programs are being initiated to gather information that has already been developed. Any effort that does not assign the highest priority to the transfer of research data to the user is useless. Separate abstracts were prepared for two included reports.

5087 (ANL/LRP-TM—8) **Abandoned mine land reclamation plan.** O'Connor, S.H.; Zellmer, S.D. (Argonne National Lab., IL (USA)). 1977. Contract W-31-109-ENG-38. 34p. Dep. NTIS, PC A03/MF A01.

The responsibility of an abandoned mine land reclamation plan must be to gather information concerning the number of acres, location, ownership, condition, environmental damage resulting from the condition, the cost of acquiring and reclaiming the land. Possible future uses, legal tools available to the state, and incentives to private interests in reclaiming the land must be considered. Factors which should be dealt with when compiling this information include: geology, topography, surface drainage, the productivity and structural qualities of the soils, habitat and vegetation, climatological data, existing land use and a visual analysis. Information necessary in making determinations concerning future land uses include: socio-economic characteristics, demographic trends, historical development, transportation and water supply. This study demonstration project concerns itself with the area located within the southeastern portion of Macoupin County, 60 miles southwest of Springfield, Illinois. In general, the groundwater from shallow wells in the area is very hard and contains large quantities of iron. The surface waters have also been affected to some degree by the refuse piles.

5088 (ANL/LRP-TM—12) **Land reclamation program description.** (Argonne National Lab., IL (USA)). May 1977. Contract W-31-109-ENG-38. 117p. Dep. NTIS, PC A06/MF A01.

The Land Reclamation Program will address the need for coordinated applied and basic research into the physical and ecological problems of land reclamation, and advance the development of cost-effective techniques for reclaiming and rehabilitating mined coal land to productive end uses. The purpose of this new program is to conduct integrated research and development projects focused on near- and long-term reclamation problems in all major U.S. coal resource regions including Alaska and to coordinate, evaluate, and disseminate the results of related studies conducted at other research institutions. The activities of the Land Reclamation Laboratory program will involve close cooperation with industry and focus on establishing a comprehensive field and laboratory effort. Research demonstration sites will be established throughout the United States to address regional and site-specific problems. Close cooperation with related efforts at academic institutions and other agencies, to transfer pertinent information and avoid duplication of effort, will be a primary goal of the program. The major effort will focus on the complete coal extraction/reclamation cycle where necessary to develop solutions to ameliorating the environmental impacts of coal development. A long-range comprehensive national reclamation program will be established that can schedule and prioritize research activities in all of the major coal regions. A fully integrated data management system will be developed to store and manage relevant environmental and land use data. Nine research demonstration sites have been identified.

5089 (CONF-7710136—, pp 92-96) **Control of trace elements during the increasing development of coal for energy.** Wixson, B.G.; Bolter, E. (Univ. of Missouri, Rolla). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The increasing development of coal resources to meet our energy crisis has resulted in new environmental concerns, especially in the trace element area. There is a need for more knowledge on the geochemical composition and concentrations of potentially hazardous trace elements associated with the mining, processing, transport, and energy conversion of coal. Such research will allow for the development of needed coal resources through the prevention, control or recovery of trace elements that might otherwise present environmental and health problems.

5090 (CONF-7805118—1) **Chemical speciation in fly ash leachate: importance and determination with special reference to arsenic.** Turner, R.; Elwood, J.; Feldman, C.; Lindberg, S. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

From EPRI workshop on fly ash research needs; Palo Alto, CA, USA (24 May 1978).

The chemical form of trace elements in ash leachate is largely unknown and can only be inferred from thermodynamic considerations presuming chemical equilibrium. Unfortunately most aqueous systems in the environment are probably not at chemical equilibrium, thus speciation can only be determined with certainty by empirical methods. Exploratory studies are being performed to determine the behavior and chemical form of arsenic in natural leachate from several coal ashes. These studies have illustrated the utility of the empirical approach to leachate behavior and speciation in deciding when and where in an ash disposal system arsenic, or some other toxin, may constitute an environmental problem. Preliminary findings are suggestive of a generic problem and constitute the basis for our contention that additional research is necessary to identify the factors, such as coal type, combustion conditions, and disposal methodology, which determine the leachability and chemical form of arsenic in ash disposal systems. Additional research should examine both temporal and spatial variations in arsenic speciation (and other toxic elements which would be expected to exhibit similar behavior in the environment) in selected typical ash disposal systems. Particular emphasis should be placed on identifying the physical/chemical factors which regulate mobilization of arsenic from coal ash and speciation of arsenic (and other toxic elements) in ash leachate.

5091 **How BSC's Redcar project is setting a standard for environmental control.** Gordon, J. *Iron Steel Int.;* **51**: No. 1, 27-39(Feb 1978).

This paper includes details of air pollution control equipment which will be used in the coal stockyards and on coke ovens. Charge preheating and pipeline charging will be practiced. Dust and sulfur dioxide levels will be monitored at a number of points in and near the plant.

5092 **Trace element measurements at the coal-fired steam plant.** Lyon, W.S. Cleveland; CRC Press, Inc. (1977). 145p. $32.95.

The procedures and results of a mass balance study of elements around the Thomas A. Allen coal-fired steam plant in Memphis, TN, are presented. Chapters are included on sampling and

preparation, neutron activation analysis, mass spectrometry for elemental analysis, electron microscopy, other analytical methods, mass balance calculations, results, particle studies, environmental studies, atmospheric modeling and discharge, and unfinished tasks and recommendations for future work. (JRD)

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 5013, 5144, 6086

5093 (USGS-OFR—76-811) **General geology and mineral resources of the coal area of south-central Utah.** Sargeant, K.A.; Hansen, D.E. (comps.). (Geological Survey, Washington, DC (USA)). 1976. 134p. GPO.

This report is a summary of the topography, physiography, geology, coal and other resources, and geologic hazards of the coal areas of south-central Utah. The report area lies generally between lat. 37° and 38°N. and long. 111° and 113°W. Despite the magnitude of structure and of canyon erosion, large areas of Late Cretaceous coal-bearing rocks have been preserved within synclinal and basin structures. On a regional basis, the coal-bearing rocks are preserved within the Kaiparowits basin and the extension under the Aquarius plateau, within the synclinal fold that underlies the Paunsaugunt Plateau and Skutumpah terrace, and within the rocks dipping uniformly northeastward under the Kolob terrace and the Markagunt Plateau. The coal deposits of south-central Utah are very large potential sources of energy. They are separated east to west by geography and geology into three major coal fields. These are the Kaiparowits Plateau, Alton (Kanab), and Kolob fields. The coal deposits occur in a plateau-and-canyonland physiography, which is in an area of rugged relief at elevations from 5,000 to 9,200 feet (1,500 to 2,760 m) above sea level. Except for some sustained and briefly intensive mining in the Coal Creek-Cedar Mountain areas of the Kolob field, production has been of an intermittent nature and the mines have been of small areal extent. This is generally an isolated area far from large markets and from accessible bulk transportation facilities. (LTN)

5094 (USGS-OFR—77-169-D) **[Coal resources in eastern part of southern Alaska]. Open file map report.** (Geological Survey, Washington, DC (USA)). 1977. vp. Geological Survey, Washington, DC.

This map shows coal fields and distribution of coal-bearing rocks in the eastern part of southern Alaska.

5095 (USGS-OFR—77-482) **[Coal maps, Dickinson area (Billings, Dunn, Stark Counties) in North Dakota].** (Geological Survey, Washington, DC (USA)). 1977. vp. Geological Survey, Washington, DC.

Thirteen maps are included on the coal beds in the Dickinson Area (Billings, Dunn, and Stark counties) in North Dakota: general columnar section, coal data base map, correlation cross sections, isopach, structural contour, overburden isopach, and interburden isopach (between Heart River (E) and Fryburg (D) coal beds). The following coal beds are covered: C coal zone, Dickinson coal bed, Fryburg (D) coal bed, and Heart River (E) coal bed. (DLC)

5096 (USGS-OFR—77-887) **Exploratory drilling in the Coalmont coal field, Jackson County, Colorado, June—November 1977.** Madden, D.H. (Geological Survey, Washington, DC (USA)). 1977. 140p. Geological Survey, Washington, DC.

Fifty-two holes were rotary drilled and the coal in 3 holes cored in the Coalmont coal field, Jackson County, north-central Colorado. The purpose of the drilling was to obtain information about the depth, thickness, extent, and quality of coal in the Coalmont Formation, as part of the Survey's program to evaluate and classify federally owned coal resources. Most of the holes are located within areas nominated for coal leasing by industry. Geophysical logs for each hole consist of natural gamma, spontaneous potential, and resistivity, which were measured with one probe, and density, which was measured with a separate probe. Lithologic logs were made by adjusting descriptions of 5-foot cuttings intervals to correspond with the geophysical logs. The major coal-bearing deposits are in the Coalmont Formation of Paleocene and Eocene age, which includes the Riach coal bed and several thinner coal beds. The coal occurs in the lower part of Hail's upper member of the Coalmont Formation, at least 2,400 feet above the base of the formation. The coal-bearing strata dip eastward to northward at angles generally less than 20°. Normal faults, trending north-northwestward, break the strata into numerous fault blocks, some less than 1/4-mile wide. At least 10 drill holes intersected what is tentatively correlated as the Riach coal bed. The coal is thickest (over 20 feet) in sec. 18, and it thins to the south and east. The coal bed is more than 15 feet thick in secs. 18, 22, and 28, and is at least 10 feet thick in secs. 15, 18, 19, 21, 22, 27, and 28. The other coal beds in the area are thinner and are probably of much less economic value than the Riach coal bed.

5097 **Compu-Log concept and practice.** Kinkade, R.; West, J.; Hallenburg, J. pp S1-S9 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

The Compu-Log system is a computer based mineral logging system. The system handles and transmits all information digitally at all times. The information is recorded in raw form and processed by the computer on site. The result is a greater speeded-up logging system of vastly improved accuracy, flexibility, and versitility. Raw data and processed data are available at the location. The Version 3 Compu-Log is the 3rd generation of a computer-centered logging system using the trade name Compu-Log by Century Geophysical Corporation.

5098 **Coal drilling at Trail Mountain, North Horn Mountain, and Johns Peak areas, Wasatch Plateau, Utah.** Davis, F.D.; Doelling, H.H. Salt Lake City; Utah Geological and Mineral Survey (1977). 93p. $4.50.

The drilling of seven core holes by the Utah Geological and Mineral Survey was done under contract with the United States Geological Survey. An eighth hole was planned but was abondoned because of environmental considerations. The total footage drilled was 4,590.4 feet and included 1,935.4 feet of coring. The depth of the holes ranged from 276.4 feet to 1,158.3 feet. Drilling was mostly in the Blackhawk Formation, a coal-bearing unit of the Mesaverde Group of Late Cretaceous age; and in each hole the upper few feet of the underlying Star Point Sandstone were intersected. All but one hole intersected at least one coal bed 4 feet or thicker, the thickest being 9.3 feet. Three areas were investigated, Trail Mountain, North Horn Mountain, and Johns Peak. At Trail Mountain the Hiawatha bed ranges in thickness from 4.5 to 9.3 feet and averages a little over 7 feet. Only in one hole was more than one minable seam found. One hole was drilled in western North Horn Mountain, but no thick coal bed was intersected. The important coal bed penetrated in the Johns Peak area is thought to be the upper Ivie and is 4 to 6 feet thick.

5099 **Preliminary estimate of the demonstrated reserve base of coal on Indian reservations.** Washington, DC; Bureau of Mines (1976). 3p.

Preliminary estimates indicate that coal on Indian reservations totals approximately 18.6 billion tons, constituting on the order of four percent of the demonstrated reserve base of coal available for mining in the United States, remaining as of January 1, 1976. This estimate is for coal on Indian reservations west of the Mississippi River; there is no known coal of minable thickness on Indian reservations in the eastern part of the United States. Therefore, the above estimate would indicate that on the order of eight percent of the demonstrated reserve base of coal west of the Mississippi River lies within the boundaries of Indian reservations. Breaking this down further, Indian reservations appear to contain nearly seven percent of the demonstrated reserve base of surface-minable coal in the West, and five percent for the total United States. The comparable proportions for underground-minable coal are nine percent and four percent, respectively.

5100 **Development of remote sensing techniques for assessment of hydrologic conditions in coal mining regions of Appalachia.** Pope, C.D. (Kennedy Space Center, Cape Canavarel, FL); Higer, A.L.; Coker, A.E. pp 5.5-5.10 of Proceedings of the twelfth space congress. Cape Canaveral, FL; Canaveral Council of Technical Societies (1975).

From 12. space congress; Cocoa Beach, FL, USA (9 Apr 1975).

In December of 1974 the John F. Kennedy Space Center, NASA, and the Water Resources Division, United States Geological Survey (USGS), acquired photographic, thermal, and multispectral data over the Cumberland region of eastern Tennessee. This data was effectively used to delineate ground water sources and surface water runoff into river systems in the Cumberlands. The data, coupled with an overview of the area from the Earth Resources Technology Satellite (ERTS), could be useful in determining hydrologic conditions in coal mining regions of the Appalachians.

MINING

REFER ALSO TO CITATION(S) 4955, 5084, 5085, 5086, 5088, 5130, 5143, 5145, 5147, 5153, 5154, 6086, 6613

5101 (FE—8915/T2-2) **Longwall conveyor system study. Final technical report as of 28 February 1978. Volume II.** Herhal, A.J.; Pimentel, R.A.; Douglas, W.J. (Ketron, Inc., Wayne, PA (USA)).

Jun 1978. Contract ET-77-C-01-8915. 130p. Dep. NTIS, PC A07/MF A01.

5102 (FE—9099-1) Factors affecting the service of large-diameter wire rope. Beeman, G.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1978. Contract ET-76-C-01-9099. 193p. Dep. NTIS, PC A09/MF A01.

Service life of large-diameter wire rope is a major concern in the surface coal mining industry. Differences in rope construction may play an important role in service life and performance. Many of the factors affecting large rope service life could be economically studied and remedial proposals evaluated using small rope if results from small rope tests could be reliably projected to large rope behavior. An experimental study to explore this possibility was begun. A fatigue machine to test large-diameter wire rope was designed, constructed, and operated. Fatigue life results were plotted and compared with results from small-diameter wire rope by employing the Drucker--Tachau Bearing Ratio. Examination of fatigue-tested ropes disclosed broken wires, cracked wires, and wear patterns. Most severe damage was in double-flex regions caused by wire notching between strands and the IWRC, not between adjacent strands. Selected sections of field ropes from seven mines at scattered sites across the U.S. were also examined for broken wires, cracks and wear. From 29 hoist and 32 drag rope sections dissected, worst damage was found in the drag rope near the sockets. Wire notching between strands and the IWRC was seldom more severe than external abrasion. Hoist rope damage was generally worst due to rope on sheave abrasion at the point sheave. Based on the markedly deleterious effects of high loads in the bending fatigue tests, and the observations of damage in both drag and hoist ropes, it is concluded that rope life in surface coal mining draglines can be extended by reducing overloads on both hoist and drag, and by reduced drag rope whip, in addition to other good maintenance practices that would lessen external abrasion.

5103 Apparatus for drawing the shearers. Nakajima, S.; Endo, H. (to Taiheiyo Engineeing Inc.). US Patent 4,099,786. 11 Jul 1978. Priority date 31 Aug 1976, Japan. 4p.

Apparatus for drawing shearers comprises a conveyor on which the shearers move with sledges interposed there between and which is arranged along a long-walled pit face of a coal mine shearers drawing cable is arranged in fixing members which are arranged on the conveyor, and a pair of means are provided for releasing and fixing the cable from and into the fixing members, the means being arranged adjacent to the sledges and the cable located between the cable releasing and fixing means being engaged with a cable driving means housed in each of the shearer bodies, wherein a drawing force is applied only to the cable located between the cable releasing and fixing means when the driving means is rendered operative.

5104 Representatives of miners; notification of legal identity; processing hazardous conditions complaints; petitions for modification of mandatory safety standards. *Fed. Regist. (Wash., D.C.);* **43**: No. 131, 29508-29509(7 Jul 1978).

From Mineral Resources, filing and other administrative requirements, 30-gCFR40-o; 81, Mine Safety and Health Administration. Representative of miners, coal mine health and safety; Procedures for identification of representatives of miners at mines.

This rule governs the identification of representatives of miners for all mines and sets forth filing requirements for such representatives. This rule replaces 30 CFR Part 81, which applied only to the representative of miners at coal mines. There was no rule applying to representatives of miners at metal or nonmetal mines. The Federal Mine Safety and Health Act of 1977 (Mine Act), requires the Secretary of Labor to exercise many of his duties under the act in cooperation with miners' representatives. The Mine Act does not define the term "representative of miners." This rule defines the term, and also incorporates into the definition similar terms used throughout the Mine Act. The rule contains requirements respecting filing of specified identification data, requirements respecting designation of persons to exercise the functions of a representative under provisions of the Mine Act, a requirement that identification data be posted at each mine, and a provision respecting termination of representatives.

5105 Notification of legal identity, coal mine health and safety. *Fed. Regist. (Wash., D.C.);* **43**: No. 131, 29510-29513(7 Jul 1978).

From Mineral Resources, 30gCFR41o, 82, Mine Safety and Health Administration. Notification of legal identity, coal mine health and safety.

This rule requires each operator of a coal or other mine to file specified information with the Secretary respecting the operator's legal identity and sets forth the procedures for filling such notification of legal identity. Section 103(h) of the Federal Mine Safety and Health Act of 1977 (act) authorizes the Secretary of Labor to require the operator of a coal or other mine (metal and nonmetal) to provide such information as the Secretary may reasonably require from time to time to enable him to perform his functions under the act.

5106 Rules of practice for petitions for modification of mandatory safety standards. *Fed. Regist. (Wash., D.C.);* **43**: No. 131, 29516-29524(7 Jul 1978).

From Mineral Resources, 30CFR44, Mine Safety and Health Administration. Rules of practice for petitions for modification of mandatory safety standards.

These rules set forth procedures for filing, processing, and deciding petitions filed under Section 101(c) of the Federal Mine Safety and Health Act of 1977 (act) for modifying application of any mandatory safety standard to a coal or other mine. The act permits the Secretary to grant petitions for modification if he determines that the result of the modification will meet certain criteria. The Secretary promulgates the rule below to govern the petition and determination procedure.

5107 Human engineered cabs. *Technol. News;* No. 51, vp(Jul 1978).

Mining machine cabs were built to comfortably fit 90 percent of adult American males, and have controls that allow fast natural reactions during emergencies. The operators are positioned for good visibility and for protection from roofing and ribbing hazards. Two basic designs were developed, one for seam heights on the order of 4 feet, and the second for seam heights near 8 feet. The controls are designed and placed to allow operation with minimum physical strain and fatigue. Automotive-type steering wheels and automotive pedal location for tramming and braking were used on the cutter, face drill, roof bolter, and shuttle cars. On some machines a pull-out steering wheel adjustable to the preference of the operator was used. Powered vertical adjustment of the entire cab was provided on some machines.

5108 Mining machine conveyor and apparatus for controlling the tension thereon. Freed, D.L. Jr. (to National Mine Service Co.). US Patent 4,090,601. 23 May 1978. Filed date 9 Nov 1976. 14p.

A mining machine having a body portion mounted on propelling tracks includes an endless conveyor mechanism that extends longitudinally on the body portion. The conveyor mechanism is rotatably supported at the front and rear end portions thereof by roller assemblies. The rear roller assembly is longitudinally movable and driven by a hydraulically operated motor to advance the conveyor mechanism from a receiving end portion to a discharging end portion. The discharging end portion is supported for lateral swinging movement relative to the main conveyor portion. Hydraulically operated take-up devices are connected to the rear roller assembly and maintain a preselected tension on the conveyor to prevent slack developing therein. Each take-up device includes a cylinder with a rod having a shoulder portion of a preselected differential area against which fluid pressure is applied to extend the rod from the cylinder. The fluid pressure in each cylinder is supplied from the hydraulic circuitry of the conveyor drive motor. Thus, the cylinders are load sensitive so that an increase in the load on the conveyor drive motor, as when the conveyor is swung laterally, results in an increase in force upon the rear roller assembly to take-up the slack in the conveyor. This avoids excessive tension on the conveyor when the conveyor portions are aligned. Only that force required to prevent slack from developing is applied to the conveyor by the take-up devices.

5109 Early detection of spontaneous heatings underground. Misra, A.K. (Indian School of Mines, Dhanbad). *Met. Miner. Rev.;* **17**: No. 4, 118-119, 120-124(Mar 1978).

The results presented give typical trends of various ratios and measurements. The depillaring panels studied were laid out for a normal 9 to 12 months working life. The salient points discussed in the earlier chapter and also a few other important factors which were observed during the authors investigations over several years can be summarized as follows: (1) Panels were sealed-off at a CO/O_2 ratio of 0.9% to 1.2% when strong heating smell appeared. (2) Rising trend of CO_2/O_2 ratio also gave in many cases indications of worsening conditions. A CO_2/O_2 ratio above 50% or a steady rising trend above 40% should be taken note of. (3) A dropping and again rising trend in dry bulb and relative humidity values is indicative of worsening conditions. (4) No smell is detected up to CO values of 0.0035 (35 ppM) but in a few cases faint smell was detected at CO values of 0.0025 (25 ppM). There is a quick development in smell from faint to strong with very little rise in corresponding CO values. No smell has been detected below 0.0025% CO (25 ppM). (5) There is a strong suspicion of the phenomena of CO-disappearance. (6) Measurements should be made preferably a few feet inbye goaf-edges in still atmospheres where the quantity of air is small. (7) In two cases, not discussed in this paper, CH_4 was detected some 10 days before the sections were sealed off. CH_4 percentage was about 0.1%. Other indications of heating were also present. This suggests that sudden appearance of CH_4 can be taken as a sure guide to fairly

advanced stage of heating. CH_4 probably was a distillation product of heating.

5110 National Coal Board statistical tables, 1977—1978. London; National Coal Board (1978). 13p.

5111 Making transducers and sensors which lead to safer mining. Laird, R. *Engineer (London);* **245**: No. 6343, 21-22, 106(20 Oct 1977).

MRDE work on transducers and sensors is described. A device containing a radioactive source has already been developed for detecting the edge of a coal seam; on a device which senses the edge of the seam by measuring natural radiation form the neighbouring rocks. Hard bands or dirt in a seam can be located by measuring pick force or pick vibrations. Environmental monitors, sensors for measuring pressure and flow in methane drainage pipes, vibration monitors for fans, means of detecting cage position in pit shaft, and bunker control systems are also mentioned.

5112 Life-blood of industry. Bratchenko, B.F. *Coal Energy Q.;* No. 14, 9-18(Aut 1977).

Despite a declining share in the Soviet Union's energy supplies Soviet coal output has increased 330 percent since 1940 and constituted a fifth of world output in 1976. This article deals with production plans, mechanization, opencast developments, the management structure, research, and the welfare and high standing of Soviet mineworkers, and concludes that, thanks to the expansion of the national economy, the continuing growth of the coal industry is assured.

5113 Work at Bergbau-Forschung GmbH on equipment and systems for heading, shaft sinking, and tunnelling. Knickmeyer, W. *Glueckauf;* **113**: No. 17, 843-847(1 Sep 1977). (In German).

Existing and planned equipment for use in the development of heading, shaft sinking and tunnelling equipment are described.

5114 CSIRO study to improve coal mining safety. *Queensl. Gov. Min. J.;* **78**: No. 908, 257-259(Jun 1977).

An account is given of a programme of work being carried out at CSIRO (Australia) which is attempting to relate tectonic structures in coal measures strata with the incidence of colliery roof failure, and to develop techniques for predicting potentially dangerous structural conditions.

5115 Installation of the KM-81 complexes in the long working faces of the upper and lower K_{12} seam layers. Akbasov, E.N. *Ugol;* No. 4, 11-14(Apr 1977). (In Russian).

The installation of the KM-81 excavator with the aid of the K-1 erecting cranes is described. 2 illustrations.

5116 High-speed mining at the Abashevskaya mine. Shinkarenko, V.S.; Popkov, M.P.; Korshunov, V.A. *Ugol;* No. 4, 14-17(Apr 1977). (In Russian).

The experience of technically advanced tunneling brigades in high-speed mining operations is described. 1 table, 3 illustrations.

5117 Effect of hydraulic transport on the characteristics of packing materials. Reshetnev, E.K. *Ugol;* No. 4, 18-20(Apr 1977). (In Russian).

Results of experimental research on determining the effect of hydrotransport length on changes in basic packing material characteristics are presented. 1 table, 5 illustrations.

5118 Optimization of reliability of mineral extraction under unstable mining-geological conditions. Krashkin, I.S.; Ledyan, A.M. *Ugol;* No. 4, 21-25(Apr 1977). (In Russian).

Problems in determining optimal reliability in extraction operations, during which stable mine operation is achieved, are examined. 6 illustrations, 3 references.

5119 Improving the preparation and operation of excavation fields at the Kuzbass mines. Manko, A.A.; Dvoretskii, N.M.; Lebedev, B.K. *Ugol;* No. 4, 25-28(Apr 1977). (In Russian).

Recommendations and technical suggestions are made for improving the preparation and operation of excavation fields in Kuzbass mines.

5120 Industrial tests on non-pillar working of thick fire-prone seams. Khardin, N.N.; Novikov, V.Ya.; Aleksandrov, V.A. *Ugol;* No. 4, 29-33(Apr 1977). (In Russian).

Results are given for the level wall and downwall working of thick fire-prone K_{12} "Upper Marianna," D_6 "Kassinskii," and K_{10} "Feliks" seams without leaving pillars or airways. 4 illustrations, 1 table.

5121 Working of gentle sloping beds without leaving intercolumnar coal pillars. Kornilkov, V.N.; Grishchenko, G.T.; Sytnikov, N.N. *Ugol;* No. 4, 34-37(Apr 1977). (In Russian).

The non-pillar preparation and working of coal seams without leaving pillars in the Chelyabinsk basin are described. 4 illustrations.

5122 Evaluation of oversize in underground working operations. Kolesnikov, V.I. *Ugol;* No. 4, 38-39(Apr 1977). (In Russian).

A methodology is presented for making adjustments in transport equipment when evaluating oversize by sample measurements. 2 tables, 2 illustrations.

5123 Computing the productivity of continuous-operation machine collectives in open-pit mining. Medikov, N.N.; Rudakov, A.A. *Ugol;* No. 4, 40-41(Apr 1977). (In Russian).

A method is presented for designing complex mining and transport machines. 2 illustrations.

5124 Test results for hydraulic-driven props of a clearing mechanized UMK. Mikhaylov, I.F.; Snigirev, V.M.; Podkolzin, A.A. *Ugol;* No. 4, 43-45(Apr 1977). (In Russian).

Results are cited for industrial tests on the hydraulic drive of the UMK complex, and the operational characteristics of hydraulic drive in mine operations are analyzed. 1 table, 2 illustrations.

5125 Improving the methods of constructing protective pillars. Polyakov, A.K. *Ugol;* No. 4, 56-59(Apr 1977). (In Russian).

A method is given for calculating the dimensions of protective pillars in coal mines. This method results in substantially smaller dimensions for the pillars without loss of pillar strength and safety. (JSR)

5126 Coal industry of the USSR in 1976. *Ugol;* No. 4, 67-71(Apr 1977). (In Russian).

Statistical data on the coal industry of the USSR are compiled in tables. These data include the tonnage produced by coal basin and by mining method, coal tonnage classified by end use, mechanization in coal mining, tonnage produced in underground and surface mining, and tonnages produced by various brigades. (JSR)

5127 Twenty-five years of the common market in coal, 1953—1978. Luxembourg; Commission of the European Communities (1977). 188p. (In several languages).

The development of the common market for coal is traced from its creation on 10 February 1953 by the High Authority of the European Coal and Steel Community up to the recent past. Describes the position assumed by coal in the Community's energy supply, the changes on the individual markets for solid fuels and the development of the factors affecting supply, including technical progress in the Community's coal mining industry. The changes which have transformed the world energy market are also described. There follows an account of the role played by the Community, in particular the ECSC executive, in the various stages of development of the common market in coal. Chapter 3 deals with the consolidation during the transitional period provided for in the ECSC Treaty; Chapter 4 describes the events of the coal crisis and Chapter 5 is devoted to Community energy policy since the oil crisis of 1973/74 from the coal industry's viewpoint. The appendix contains 39 tables of statistics covering all important aspects of the coal sector since the common market was established.

5128 Reclamation of derelict land: procedure for locating abandoned mine shafts. London; Dept. of the Environment (1976). 92p.

A procedure for locating abandoned shafts has been compiled from the experiences of those familiar with the problem. The procedure begins with a careful study of all the maps, aerial photographs and documents related to the mining activity and may include specialized surveys using geophysical, geochemical and aerial photographic methods when specific conditions are known or are likely to exist at the site. Direct methods, of either excavation, probing or drilling are required in each instance to confirm the location. Most of the methods are illustrated with case histories, and seismic and remote sensing methods are discussed in detail in appendices. Also in appendices, specific sources of information relating to mining are listed. Physical characteristics of mine shafts which are likely to have a bearing on the finding of the shaft are discussed, and an outline of the costs of the methods is presented. A glossary of mining terms used in the document and a detailed bibliography are provided.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 4945, 4965, 5091, 5101, 5134, 5143, 5239, 5719

5129 (CONF-771203—, pp 159-161) **Feasibility study of ultrasonic/sonic flowmeters for coal slurries.** Raptis, A.C.; Doolittle, R.; Popper, G.F.; Fitzgerald, J.W.; Carey, W.M. (Argonne National Lab., IL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5130 Locomotives underground. *Mineral. Mag. J. Mineral. Soc. (1876-1968);* **138**: No. 4, 313-329(Apr 1978).

Diesel, battery and trolley locomotives for underground use are described, and manufacturers of diesel and electric locomotives are listed, together with an indication of the range of products they offer. The ATC rail haulage remote control system is also described.

5131 Briquetting technique. Ganguly, T.P.; Moitra, S.P.; Paul, M.M. (Central Fuel Research Inst., Dhanbad, India). *Met. Miner. Rev.;* **17**: No. 2, 60-61(Jan 1978).

5132 What's new in coal handling systems. Stock, J.R. Lexington, KY; University of Kentucky (1978). 10p. (CONF-780485—4).

From Industrial coal conference; Lexington, KY, USA (26 Apr 1978).

A survey of the large variety of commercially available equipment for handling coal in industrial boiler plants is presented. Some items are designs that have been in use for many years and whose operating characteristics are known; others are new designs that are essentially untried. The interrelationship between individual items of equipment in the overall coal handling system is emphasized.

COMBUSTION

REFER ALSO TO CITATION(S) 4970, 4977, 5055, 5081, 5082, 5706, 5710, 5720, 5721, 6116, 6231, 6443, 6444, 6445

5133 (CONF-771203—, pp 153-155) **Investigation of the fluid dynamics of a coal-fired fluidized bed packed with heat exchangers.** Zakkay, V.; Miller, G.; Brentan, A. (New York Univ.). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5134 (CONF-771203—, pp 163-164) **Stability and instability of coal-oil slurry fuels, some practical considerations.** Botsaris, G.D.; Glazman, Y.; Naar, R.Z. (Tufts Univ., Medford, MA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5135 (CONF-771203—, pp 45-46) **Status and future promise of fluidized bed coal combustion.** Jonke, A.A. (Argonne National Lab., IL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5136 (CONF-780801—33) **Factors limiting limestone utilization efficiency in fluidized-bed combustors.** Johnson, I.; Shearer, J.; Snyder, R.; Vogel, G.J. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The factors which determine the quantity of limestone needed to obtain acceptable SO_2 emission levels in the flue gas from fluidized-bed combustors have been reviewed. The most important factors are the mole ratio of calcium (in the stone) to sulfur (in the coal) in the feed, the gas phase residence time, the temperature, and the type of limestone. Both calcitic and dolomitic limestones have been studied since they behave differently in FBCs. The differences between atmospheric-pressure and pressurized FBCs in relation to limestone utilization are discussed. Differences in the average pore size of calcined limestones is the major cause of the differences in limestone-SO_2 reactivities in FBCs.

5137 (EPA—600/7-77-073d, pp 79-100) **Fate of fuel nitrogen during pyrolysis and oxidation.** Song, Y.H.; Beer, J.M.; Sarofim, A.F. (Massachusetts Inst. of Tech., Cambridge). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

Regulation of nitric oxide emissions by modification of coal combustion processes requires a better understanding of the mechanism of fuel nitrogen conversion to nitrogen oxides. To this end, the fate of coal nitrogen in both inert and oxidizing atmospheres has been studied in a laboratory furnace at temperature levels and for time intervals of interest in pulverized coal combustors. Data on the overall conversion of coal-nitrogen into nitrogen oxides obtained at several different temperatures are reported. Oxidation experiments were carried out with both coal and char to enable the respective contributions of coal volatiles and char to the emissions of nitrogen oxides to be determined. The char used in the oxidation studies was prepared by pyrolysis of coal at the temperature and residence time of the corresponding oxidation experiments. The conversion to nitric oxide of char-nitrogen was lower than that of coal-nitrogen. The yields of nitric oxide from both coal- and char-oxidation were found to decrease monotonically with increasing fuel/oxygen ratios. Results also show that the conversion of fuel nitrogen to nitrogen oxides decreases slightly with increasing temperature. Rates of oxidation of char and char nitrogen were determined at temperatures of 1250 to 1750°K and oxygen partial pressures of 0.2 and 0.4 atmosphere. The char in these latter studies was produced by pyrolyzing coal particles at 1750°K during a residence time of one second. The variation of nitrogen/carbon ratio of the char samples with time suggests that oxidation and pyrolysis of the char nitrogen occur simultaneously.

5138 (FE—2437-5) **Feasibility study of using a coal/water/oil emulsion as a clean liquid fuel. Phase 2, second year. Interim report, October—November 1977.** Dooher, J.P. (Adelphi Research Center, Inc., Garden City, NY (USA)). Dec 1977. Contract EX-76-S-01-2437. 16p. Dep. NTIS, PC A02/MF A01.

The combination of new nozzle design and increase in diameter of the burner tip tubing enabled us to burn successfully an emulsion made with Kentucky coal. Thus, burner design is an important consideration in the combustion of emulsion fuels. Results relating to emulsion viscosity and measuring methods are reported as follows: Poiseuille's equation relating pressure drop in a pipe, the flow rate through the pipe, and the viscosity of the fluid cannot be directly applied to emulsions because we are not dealing with a Newtonian fluid but a thixotropic, pseudoplastic one. A Newtonian fluid's viscosity is not affected by changing shear rate nor with time at a constant shear rate. Our research has shown that the viscosity of coal/water/oil emulsions changes both as a function of shear rate and of time. Another reason for the lower viscosity measured in a pipe could be the migration of the coal toward the axis of the pipe. Work done by the Research Council of Alberta, Edmonton, Alta., on pipeline flow has shown that for coal-in-oil suspensions the concentration is not constant across the diameter of the pipe. The coal tends to concentrate in a central core. This same phenomenon could be present in coal/water/oil emulsions and would explain the lower viscosity measured in pipes. When the viscosity of emulsions is measured in the Rotovisco, the emulsion is in a Couette flow pattern, while it perhaps follows a Poiseuille flow in the pipe. This difference could also contribute to the discrepancy between measured viscosities. From our data, there seems to be a fixed ratio for each emulsion between the pumped and measured viscosity. This ratio is lower for the less viscous emulsions; whereas also the change in viscosity with increasing time is lower percentagewise than for the more viscous emulsions.

5139 Status of technology of fluidized beds for the combustion of solid fuels. Bryers, R.W. (Foster Wheeler Energy Corp., Livingston, NJ); Kramer, W.E. pp 27-54 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The addition of a cooling surface to a fluidized bed is an innovation which should improve cycle efficiency and, thus, the economics of the combustion of wood. Other advantages implicit in the fluidized bed are a reduction in size and reduction in heat-transfer surface, absence of slagging, controlled emissions without large, expensive flue-gas scrubbing equipment, lower unit costs, increased availability and greater turndown ratio. Although the concept of fluidized-bed combustion with immersed heat-transfer surface has not been proven with wood, it is presently being tested with coal. Plans are under way for a study on the economics and technical problems involved in a large, wood-fired, fluidized-bed steam generator. A successful conclusion of the study is anticipated, after which a demonstration program will be instituted. The significant benefits outlined make the fluidized-bed combustion process a preferred alternate to conventional units requiring stack-gas clean-up equipment. The development and demonstration of the fluidized-bed system for industrial, institutional, and utility applications is in keeping with a sensible energy program for the U.S.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 5008, 5110, 5112, 5127, 6024, 6088

5140 (SAND—78-0941, pp 135-144) **Preliminary evaluation of western markets for UCG-derived fuel gas.** Moll, A.J.; Olsen, D.L. (SRI International, Menlo Park, CA). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

This paper examines the market prospects of underground coal gasification (UCG) for the production of low-Btu fuel gas. The markets for low-Btu fuel gas are found to be potentially large especially for the generation of electricity to satisfy California's requirements. The size of this market will depend on the cost of the electricity, transmission requirements, environmental regulations, and state policy regarding power plants dedicated to export electricity. An eleven-state area in the Rocky Mountains and the Great Plains is evaluated for purposes of determining future fuel and electricity requirements. Eight Midwestern and Pacific states on the periphery of the primary region are considered a secondary demand region for UCG-derived power. The total new base-load thermal power capacity to be installed in the eleven-state area between 1985 and 2000 will be about 26,000 megawatts. The corresponding capacity in the peripheral states will be about 130,000 megawatts. It is estimated in this paper that UCG-derived power can capture up to 20,000 megawatts of this market equivalent to over 10^{15} Btu (1 quad) of fuel gas per year. No significant industrial or chemical markets are foreseen for LBG or IBG until at least the year 2000. It is speculated in this paper that an economical SNG process (UCG or otherwise) would capture an additional 0.5 quad of the pipeline gas market each year after 2000.

5141 (SAND—78-0941, pp 145-156) **Economics of four options to utilize underground gasification of Kaiparowits coal to generate electricity.** Bidlack, D.L. (Gulf Research and Development Co., Pittsburgh). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

Four options were considered for utilizing underground gasification of Kaiparowits coal to manufacture fuel from which electricity is generated. The electricity is assumed to be used in Los Angeles, although the analysis applies equally well to any of the population centers in the Southwest. The manufactured fuels for the four options are substitute natural gas (SNG), medium heating value (MHV) fuel gas, fuel grade methanol, and low heating value (LHV) fuel gas. Oxygen/water is the gasifying agent for making SNG, MHV fuel gas, and methanol; air/water is the gasifying agent for making LHV fuel gas. In the summary table (1977 basis), the SNG is pipelined to a power plant located in Los Angeles, while the other three options involve firing the manufactured fuel in a nearby power station and transmitting the electricity to Los Angeles. The MHV fuel gas is preferred option; it is also the only option competitive with electricity generated by a conventional coal-fired power station.

5142 (SAND—78-0941, pp 177-189) **Estimated costs of electricity, SNG, and syngas from in situ coal gasification.** Ulrich, W.C.; Edwards, M.S.; Salmon, R. (Oak Ridge National Lab., TN). Jun 1978.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

In Proceedings of the 4th underground coal conversion symposium.

Conceptual process designs and cost estimates are presented for three potential applications of underground coal gasification: (1) a 900 MW(e) combined-cycle electric generating plant fueled by low-Btu gas, (2) a substitute natural gas (SNG) plant producing 155 MMscfd of 954 Btu/scf gas, and (3) a synthesis gas (snygas) plant producing 388 MMscfd of gas suitable for further chemical conversion. Designs were based on experimental data obtained at the Laramie Energy Research Center on subbituminous coal using the linked vertical well in situ gasification process. Respective capital investments were estimated to be $423, $376, and $334 million in first-quarter 1978 dollars. Product prices were calculated as a function of the debt/equity ratio, the annual earning rates on debt and equity, the cost of coal, and plant factor (onstream efficiency). Using a debt/equity ratio of 70/30, an interest rate on debt of 9%, an after-tax earning rate on equity of 15%, and a coal feed cost of $5/ton, product prices were 24 mills/kWh for electricity at 70% plant factor, and $2.89/$10^6$ Btu for SNG and $2.48/$10^6$ Btu for syngas at 90% plant factor. Calculated overall thermal efficiencies for the three facilities were 24, 38, and 40% respectively, based on in-place coal.

5143 **Statistical summary of coal mining, coking, and briquetting plants and review of the solid fuels market in 1976.** Medaets, J. *Ann. Mines Belg.;* 541-567(May 1977). (In French and Dutch).

This paper reviews the activities of the Belgian coal and coke industry noting that some of the figures are still provisional. Figures are given for production and stocks of coal; personnel; productivity; working hours; salaries; and the production of coke and briquettes.

5144 **Summary statement of background, conclusions, and recommendations regarding future specific programs of industrial development in northern Missouri based upon coal conversion-utilization strategies.** Streich, R.P. Trenton, MO; Green Hills Regional Planning Commission (1977). 12p.

Based upon three years of attention to various aspects of exploiting Missouri coal, especially in the northern area of the state, this department concludes generally (1) that there exists within the State of Missouri a real and immediate need for a continuing, structured effort to use its coal resources; (2) that one or more strategies for an expanded coal extraction-utilization sector of industry can be practical, workable, and advantageous to citizens, businesses, and industries in the State of Missouri; and (3) that proper exploitation of coal in the coal-bearing region will have a profound effect on the economy of the entire state, stimulating growth of population and industry, as well as employment and income opportunities. This department further concludes, specifically: (4) that implementation of moderate-sized coal conversion facilities within northern Missouri is both practical and feasible, with hardware and technology available to make such facilities impending realities; and (5) that immediate benefits derived from such facilities, strategically located, and from the support efforts in mining, would include the creation of many new employment opportunities, a relaxation of the limited availability of some nonenergy products such as synthetic fertilizers, and stabilization and partial redirection of an essentially stagnant agricultural economy. Details of the study and recommendations for further work are given.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 5107, 5109, 5152, 6450, 6541

5145 **Improving mine evacuation through computer simulation.** Boghani, A.B. *Mineral. Mag. J. Mineral. Soc. (1876-1968);* **138**: No. 4, 354-359(Apr 1978).

A computer program has been developed which predicts the time necessary for evacuation of a mine under different circumstances. From a study of the predictions, problem areas which affect the evacuation time can be identified, and suggested solutions can be tested without actual fire drills in the mine.

5146 **Coal miner's pneumoconiosis.** Amoudru, C. *Ann. Mines;* 59-62(Jan 1978). (In French).

Coal miner's pneumoconiosis is one of the most serious and widespread occupational diseases in the world. Gives statistical information on the number of working and retired coal miners in France suffering from it. It is noteworthy that the incidence of this illness varies considerably from one coalfield to another. The high number of retired sufferers, reflects on one hand, the notoriously inadequate precautions ruling 30 years ago, and on the other hand the fact that, thanks to recession in the age at which the disease shows up, to job reallocation and to medical care, pneumoconiosis is now compatible with a life-span which, little by little, is getting close to normal. Moreover improvement in working conditions has occurred; the annual number of new cases which was 2.4% in 1957 is now 0.8% in 1977, with fairly appreciable differences between coalfields.

5147 **Mine injuries and worktime, quarterly, January—March 1978.** Washington, DC; Dept. of Labor (1978). 18p.

Current data, preliminary and subject to change, are compiled from reports by operators of mines for personnel directly engaged in production, cleaning, milling, shipping, development, and maintenance and repair work, including direct supervisory and technical personnel and contract mining services. Reports are submitted as required under the Federal Mine Safety and Health Act of 1977, Public Law 91-173 as amended by Public Law 95-164.

5148 **Measurements of respirable dust in working places in a coking plant using DP50 and BAT1 instruments.** Masek, V. *Staub-Reinhalt. Luft;* **37**: No. 12, 464-467(Dec 1977). (In German).

Comparative measurements were carried out using two instruments, and mathematical relationships between the total respirable dust and dust penetrating into the lungs were evaluated. On

average, the content of lung-penetrating dust decreases with increasing concentration of total airborne dust.

5149 Filters for respiratory protection: a comparative survey. Riediger, G. *Staub-Reinhalt. Luft;* **37**: No. 10, 371-377(Oct 1977). (In German).

Methods and criteria for testing protective respiratory apparatus are standardized at the European level within the frame of the CEN (European Commission for Standardization). In the course of standardization work on suspended matter filters for protective purposes, comparative tests were carried out by institutes in charge of investigations of protective respiratory apparatus, every institute using its routine test method. Nine types of filters were tested for penetration to sodium chloride aerosol, paraffin oilmist, DOP aerosol, atmospheric aerosol and respirable quartz dust; for four types of filters their clogging characteristics for quartz dust and coal dust were determined.

5150 Safety helmet including respirator, an individual safety device which protects the head and is a breathing apparatus. Riediger, G.; Coenen, W. *Staub-Reinhalt. Luft;* **37**: No. 10, 378-382(Oct 1977). (In German).

This paper discussed the problem of combining head protection with that of the respiratory organs by using a safety helmet which filters the ambient air. For testing this type of equipment it is not sufficient simply to combine the testing regulations and criteria for industrial safety helmets and for filtering breathing apparatus. This has been shown by practical experience with a prototype developed by the Dust Research Institute in Bonn and with some other commercially available helmets.

5151 Surges in methane concentration during the reversal of aeration jets. Zinchenko, I.N.; Kovaleva, Yu.M. *Izv. Vyssh. Uchebn. Zaved., Gorn. Zh.;* No. 3, 50-53(1977). (In Russian).

An examination is made of methane diffusion in extensive mining during skip-like reversing of ventilation air streams. An analytical solution presented in a criterial form describes the dynamics of methane concentration in incoming and initial streams of the longwall and sections, and explains the cause of concentration surges whose maximal value depends on the depth of air expenditure regulation and the Peclet number. 2 illustrations, 2 references.

REGULATIONS

REFER ALSO TO CITATION(S) 5013, 5104, 5105, 5106

5152 Specifications for medical examinations of underground coal mines: chest roentgenographic examinations. *Fed. Regist. (Wash., D.C.);* **43**: No. 148, 33713-33720(1 Aug 1978).

From Public Health Service: Medical care and examinations, 42cCFR37, Public Health Service, Dept. of Health, Education, and Welfare. Specifications for medical examinations of underground coal mines.

These rules revise and update specifications governing the chest roentgenograms (X-rays) required to be given to underground coal miners by section 203 of the Federal Mine Safety and Health Act of 1977. The program was formerly conducted under section 203 of the Federal Coal Mine Health and Safety Act of 1969.

5153 Federal surface mining regulations. A guide to meeting the mandate of the law. New York; McGraw-Hill, Inc. (1978). 142p. $37.50.

The Surface Mining Control and Reclamation Act of 1977 is now the law of the land. The Act in essence is merely a broad outline of Congressional intentions regarding the surface effects of coal mining. While it mandates reclamation and return to approximate original contour, it leaves many of the detailed requirements to be worked out by the Interior Department. The Interior Department has formulated the first of those requirements in the interim regulations. These regulations are a specific attempt to translate the intentions of Congress into a workable program that will, in the words of the Act, "protect society and the environment from the adverse effects of surface coal mining." This guidebook is designed to summarize the regulations in fewer words that are more easily understood than the government's legalese. In addition, where possible, the authors have noted those areas in which further government intervention can be expected. This is important because the government's regulatory program for strip mining is still evolving and it can be safely assumed that amendments to both the Act and the regulations will be forthcoming. Significantly, President Carter has called for more stringent standards for surface mining. Considerable sentiment also exists for extending the intent, if not the technicalities of the Act, to the surface effects of all mining.

5154 Coal Mining Subsidence: how to make claims under the 1957 Act. London; Dept. of Energy (1976). 6p.

The United Kingdom Coal-Mining (Subsidence Act, 1957, may affect anybody living in a coalmining area. The act requires the National Coal Board to do three things: (a) Remedy damage to land, buildings, structures and service lines or pipes caused by coalmining subsidence or make a payment instead; (b) Provide or pay for temporary accommodation when houses are so badly damaged by coalmining subsidence that people are rendered homeless; and (c) Pay damages if anyone should be killed or seriously and permanently disabled by an accident caused directly by coalmining subsidence and there is no other claim for damages. This leaflet seeks to answer some of the questions which may be asked by people who want to make a claim under the Act.

PETROLEUM

REFER ALSO TO CITATION(S) 4941, 4942, 6084

5155 North Sea oil directory 1978: your key to the North Sea. Kingston-upon-Thames, England; North Sea Oil Directory Ltd. (1977). 702p. $20.00.

This directory covers offshore industrial firms in the fields of: exploration and production, drilling, oilfield development and management, cement and drilling fluids, drilling equipment, transmission and movers, production and process equipment, rig and platform equipment, construction, logistics, port supply bases, marine civil engineering, and specialized equipment and services. (DLC)

5156 Oil: the history of Canada's oil and gas industry. Gould, E. Saanichton, British Columbia; Hancock House Publishers (1976). 288p. $17.95.

The 18 chapters cover: search for oil, drilling equipment, Lambton County in Ontario, search out West, start of natural gas industry, Turner Valley, Norman wells and the CANDL experience, the decade after Leduc, tar sands, crude and refined petroleum, oil towns, pipelines, refining, major oil companies, independent oil companies, gas stations, government regulations, and reserves. (Over 300 photographs.) (DLC)

RESERVES

5157 (USGS-OFR—78-87) **Estimated oil and gas reserves, Gulf of Mexico Outer Continental Shelf, January 1, 1977.** Bryan, F.T.; Knipmeyer, J.H.; Schluntz, E.K. (Geological Survey, Washington, DC (USA)). 1978. 13p. Geological Survey, Washington, DC.

As of January 1, 1977, nearly 35 trillion cubic feet of gas and about 2.7 billion barrels of oil are estimated to be the remaining reserves in 294 fields in the Gulf of Mexico Outer Continental Shelf off Texas and Louisiana. Twenty-seven additional fields, discovered since January 1, 1976, in these Federal waters are not yet sufficiently developed to permit a reasonably accurate estimate of measured reserves. Nearly 66 trillion cubic feet of gas and 6.9 billion barrels of oil are estimated to have been originally recoverable from 306 fields, 12 of which are not considered to have any remaining reserves. Reserve estimates were made on a reservoir-by-reservoir basis for 146 fields and on a field-wide basis for the other 160 fields. The resulting estimates of original and remaining reserves are reported here in terms of geographic area within the Outer Continental Shelf and adjacent slope.

5158 Petroleum development in Alaska. A look at the past, present, and future potentials. *Alaska Rev. Bus. Econ. Cond.;* **14**: No. 1, 1-16(Mar 1977).

A comprehensive overview of petroleum development in Alaska is presented. The background of oil in Alaska with the focus on the role of Kenai-Cook Inlet petroleum in Alaska's economy is discussed. In the context of the international energy crisis of 1973 and 1974, a discussion of the Prudhoe Bay and trans-Alaska oil pipeline developments is included. In view of the idea that the Prudhoe Bay discovery may only signal the beginning of large-scale development in Alaska, Alaska's total oil and gas resource potential beyond Prudhoe is assessed, and key factors likely to affect the development of that future potential are discussed.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 6819, 6833

5159 (CONF-771203—, pp 203-204) **Expected costs of new hydrocarbon reserves in North America and policy implications.** Debanne, J.J. (Univ. of Ottawa). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5160 (USGS-OFR—77-475) **Petroleum geology and hydrocarbon potential of Naval Petroleum Reserve No. 4, North Slope, Alaska.** Carter, R.D.; Mull, C.G.; Bird, K.J.; Powers, R.B. (Geological Survey, Menlo Park, CA (USA)). Jun 1977. 64p. Geological Survey, Washington, DC.

An administrative report was prepared in 1976 to provide background information, to describe the state of knowledge of the geology of NPR-4, and to recommend studies necessary for an evaluation of the hydrocarbon potential of the Reserve. This paper is based on the administrative report which in turn depended upon published literature, unpublished U.S. Geological Survey data, and the background knowledge of Survey geologists with extensive experience in the regional geology and petroleum geology of the North Slope of Alaska. In addition, results of the ongoing Navy exploration of NPR-4 were made available to the Geological Survey following the signing of the The Naval Petroleum Reserves Production Act by the President on April 5, 1976. These results were reviewed for possible conflicts with interpretations and conclusions reached in this report and no incompatibilities of significance were found.

5161 (USGS-OFR—77-542) **Petroleum evaluation of the Bob Marshall Wilderness and adjacent study areas, Lewis and Clark, Teton, Pondera, Flathead, Lake, Missoula, and Powell Counties, Montana.** Rice, D.D. (Geological Survey, Washington, DC (USA)). 1977. 40p. Geological Survey, Washington, DC.

This report discusses the petroleum potential of the Bob Marshall Wilderness and adjacent wilderness study areas. In general, the study area has a good potential for natural gas accumulations from Mississippian carbonate rocks. Reservoirs may also be present in the underlying Devonian carbonates, but these are unevaluated. Clastic rocks of Mesozoic age are secondary objectives because their reservoir qualities are generally poor. Likely source beds are marine shales in the Jurassic Ellis Group, the Mississippian Allan Mountain Formation, and the Mississippian-Devonian Bakken Formation, where present. Prospective traps are primarily structural. The faulted eastern edge of reservoir rocks in the upper plate of a thrust block is the primary type of trap; associated folds are a secondary type. Structural and stratigraphic changes associated with northeasterly-trending lineaments are especially favorable for hydrocarbon accumulations.

5162 (USGS-OFR—77-593) **Summary report on the regional geology, petroleum potential, and environmental geology of the southern proposed Lease Sale 53, central and northern California Outer Continental Shelf.** McCulloch, D.S.; Clarke, S.H. Jr.; Field, M.E.; Scott, E.W.; Utter, P.M. (Geological Survey, Menlo Park, CA (USA)). Jul 1977. 62p. Geological Survey, Washington, DC.

This report summarizes aspects of offshore and onshore geology, onshore petroleum production and geological environmental hazards pertinent to the southern part of OCS Lease Sale 53, and presents an appraisal of its petroleum potential. This area encompasses the entire central and northern California continental shelf north of Point Conception. It is bounded on the northeast by the three-mile limit of the State of California OCS, on the southeast by latitude 34.50° north, on the southwest by the 1000 meter isobath, and on the northwest by latitude 42.50° north. The Oregon and Washington part of OCS Lease Sale 53 is described by Snavely and others (1977). Five sedimentary basins on the shelf have received most attention as potential areas of recoverable hydrocarbons. Several aspects of these basins suggest that they have only moderate to low hydrocarbon potential. Environmental hazards from seismic effects are addressed.

5163 (USGS-OFR—77-871) **Petroleum geology of the West Siberian Basin and a detailed description of the Samotlor oil field.** Clarke, J.W.; Girard, O.W. Jr.; Peterson, J.; Rachlin, J. (Geological Survey, Reston, VA (USA)). 1977. 141p. Geological Survey, Washington, DC.

This is the first in a series of planned studies of important oil-gas regions of the world. It is a compilation, along with some interpretation, of the geology of the West Siberian Basin and a description of the Samotlor oil field, the largest field of USSR. The Samotlor oil field produced 2,200,000 bbl/day in 1976, about 20% of total USSR oil production.

5164 (USGS-OFR—78-1-F) **Maps and table describing areas of interest for oil and gas in central Alaska.** Patton, W.W. Jr. (Geological Survey, Menlo Park, CA (USA)). 1978. vp. Geological Survey, Washington, DC.

The table gives the petroleum interest, geologic setting, and geophysical data (aeromagnetics, gravity) on areas in central Alaska. Two maps are included. (DLC)

5165 **Hydrocarbon detection utilizing neutron borehole measurements.** Tixier, M.P. (to Schlumberger Technology Corp.). US Patent 4,095,102. 13 Jun 1978. Filed date 8 Apr 1977. 32p.

Illustrative embodiments of the present invention include methods and apparatus for producing indications of the presence of hydrocarbons in subsurface earth formations. In one embodiment, two different pore volume indications are derived and comparably displayed. The first is primarily dependent upon the hydrogen content of the fluid in the pore space of the formation and may be derived from count rate ratios obtained between two epithermal neutron responsive detectors differently spaced from a neutron source. If thermal neutron or neutron captured gamma ray responsive detectors are used, compensation is provided for thermal neutron absorption effects. The second pore volume indication is produced directly from a measurement of the thermal neutron absorption characteristic of the formation and a value for the water component of the formation.

5166 (SAND—78-0549(Vol.4)(No.1), pp 6-10) **Acoustic telemetry system for use during offshore oil exploration.** Reece, E. Feb 1978.

In Sandia technology.

Design and testing of a remote data acquisition system to monitor ocean bottom sediments are described. The Experimental Sediment Instrumentation System contains three major elements: a data-gathering package, a command and recording station, and a buoy relay station. The data-gathering package is housed in a pressure vessel that rests on the ocean bottom. Inside are sensors to monitor environmental data, a preprogrammed microcomputer and signal generator, and acoustic transducers. The sensor information can be transmitted directly to a surface receiving station or stored in a random-access memory for later readout. The microcomputer contains 25,600 bytes of memory for data storage and 3,072 bytes for program storage. In addition to measuring, storing, and transmitting data, the data-gathering package can be commanded to send any one of nine fixed data patterns, at various data rates and power levels, for evaluation of the acoustic data link and for determination of bit error rates. The command and recording station is a portable unit that provides ship, air, or land-based command and data recording capabilities for the data-gathering package. Preprogrammed commands are sent from this station to control the ocean-bottom data-gathering activity. Acoustic signals can be received directly from the ocean bottom data collector, or radio frequency signals can be received as transmitted from the buoy relay station. The buoy relay station is designed to convert acoustic signals from the ocean-bottom data-gathering package to radio frequency signals and to transmit this information to the command and receiving station. The buoy can also be used to relay messages from the command station to the ocean floor. Accurate transmission of acoustic data signals through seawater at a high data rate was demonstrated during tests.

5167 **Determination of logging parameters in shaly sand.** Miyairi, M.; Itoh, T. (Japan Petroleum Exploration Co., Ltd., Tokyo). pp E1-E20 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

At the well log interpretation in shaly sand, the most reasonable values of logging parameters are found out by the use of several kinds of computer crossplot methods with a help of data from core analysis and data from well production test. The formation interpreted in this case study consists of an alternation of shaly sand and clay having a very thin bed thickness. Because an average formation resistivity at the production zone is less than 2 ohm-m, a water saturation (S/sub w/) calculated by the use of the standard values of m = n = 2, b = 2-V/sub sh/ and a = 0.8 on Poupon's equation shows always over 70% even with the formation producing gas without any water. Therefore, those logging parameters must be arranged to be a suitable value for fitting with the result of production test. The parameters of a and m on porosity term can be determined from R/sub t/-Phi crossplot, the parameter of n on water saturation term can be determined from Z-Phi crossplot basing on a formula modified of the standard equation as log Z = log Phi-log (S/sub w/Phi)/sup n/, when S/sub w/Phi = constant is satisfied at an irreducible water saturated zone, and the parameter of b on V/sub sh/ term can also be determined from X-V/sub sh/ crossplot basing on a formula modified of the standard equation as log X = b log V/sub sh/-log R/sub sh/. Where, X and Z are expressed as X, Z = f (V/sub sh/, R/sub t/, R/sub sh/, Phi, aR/sub w/). The logging parameters derived from those crossplot methods are m = 2, a = 0.85, n = 1.4, b = 2 at 0 < or = to V/sub sh/ < 0.26 and b = 1.8 at 0.26 < or = to V/sub sh/ < or = to 1 and those values coincided well with the data given by the core analysis.

5168 Log analysis in a Rocky Mountain heavy oil reservoir. Chesnut, D.A.; Cox, D.O. (Energy Consulting Associates, Inc., Denver). pp F1-F15 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

In evaluating a heavy oil accumulation in Wyoming for an enhanced recovery pilot, log analysis with conventional "clean sand" evaluation techniques was found to yield computed oil saturations much less than core saturations. The formation involved was the Tensleep, which is generally considered to be a clean sand. Formation water, however, is fresh, containing less than 800 parts per million total dissolved solids, predominantly calcium bicarbonate. Measured water resistivity is 9.4 ohm-meters at 68°F. Because of the high water resistivity, any clays which are present would decrease the resistivity recorded by the logs, compared to the resistivity that would be observed with the same pore geometry and fluid content in the absence of surface conductivity. To evaluate the possibility of clay conductance affecting the log resistivities, the cation exchange capacity (CEC) was measured on several core samples. Measured CEC's averaged 1.04 meq/100 gr. which indicates a small clay conductance. X-ray diffraction data were used to estimate CEC. For the same samples on which CEC's were measured, estimated average CEC was 1.27 meq/100 gr., indicating that X-ray diffraction data may be used to estimate cation exchange capacity with fair accuracy. The Waxman-Smits equation was then used to compute oil saturation, taking into account the clay conductance term. It was found that computed oil saturations averaged almost 50 oil saturation percent higher than comparable "clean sand" calculations. The effects of clays on computed oil saturations must be considered when high resistivity formation water is encountered. The use of "shaly sand" instead of "clean sand" methods of log analysis showed that there was enough oil content to justify considerable field testing to attempt to develop a profitable recovery method.

5169 Dipmeter log analysis: an essay. Rider, M.H. (Compagnie Francaise des Petroles, Bordeaux). pp G1-G18 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

The greatest difficulty with the dipmeter seems to be a lack of consumer confidence. This is not necessarily in the tool itself but of the manner in which it is interpreted. It is in the existing systems of analysis that the doubt lies. Quite a number of articles have been written in which comprehensive systems for dipmeter interpretation have been proposed. This paper does not have similar ambitions: it is only an essay. The first object is to compare dipmeter results with measurements and observations on cores and, where possible, to draw conclusions. A second object is to use a quasi-statistical approach to dipmeter analysis (rather than pattern analysis). This approach is used both in the comparisons with core data and in the example of interpretation which is given.

5170 Normalization techniques and interpretive practices of relative permeability curves of reservoir rocks. Mawla, R.A.; Al-Saadoon, F.T. (Al-Fateh Univ., Tripoli, Libya). pp J1-J20 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

This paper deals with normalization techniques currently used for adjusting laboratory relative permeability curves. It reviews the current state of the art with examples based on actual data. It was shown that different techniques may lead to different curves for the same set under study. Hence the intention of this paper was to establish some criteria so that the denormalized curves reflect actual reservoir characteristics. The most critical part in the normalization is the proper selection of the end points. The end points selected are those which may correlate best with parameters such as $\sqrt{k/phi}$ or k. The best normalization technique to be used is the one that retains the general flow characteristics of the reservoir rock. The present work suggests that a better selection of end points may be accomplished by using the pore geometrical factor, as deduced from capillary pressure curve, as a correlation parameter. Other tools of formation evaluation may assist in the final selection.

5171 Mineral composition, an aid in classical log analysis used in Jurassic sandstones of the Northern North Sea. Nyberg, O.; Lien, K.; Lindberg, P.A.; Smistad, J.K. (Den Norske Stats Oljeselskap a/s Statoil, Stavanger, Norway). pp M1-M35 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

The complex mineralogy of the Jurassic sandstones of the Northern North Sea have made the porosity evaluation from logs difficult. To illustrate the problems involved, two typical wells have been used in this paper. Mineralogical and chemical analysis were performed on 15 samples in well A, by thin section study and x-ray flourescence. The samples contain considerable amounts of potassium feldspar, mica and a variable amount of siderite. The chemical composition shows an appreciable amount of K_2O in accordance with the content of potassium feldspar and mica. As the characteristics of these minerals affect the logs and are significant contributors to the radioactive measurements, the quantified results of the mineral study give an important contribution to the porosity evaluation. The data from the mineral analysis together with core and logs were compiled into a computerized model for calculation of porosity. The calculated results were then compared to previous evaluations based on logs alone. The values of porosity show a significant difference where the "shaly sand approach" gives too low a porosity, even to the extent that it neglected productive zones. Based on aquired information it can be said that by introduction of quantified mineral analysis to the porosity evaluation, the confidence level of the calculated values has increased in zones where the standard petrophysical measurements do not measure the rock properties in enough detail.

5172 Relationship between the conductivities of tertiary water-bearing sands and nearby shales, offshore Louisiana. Ritch, H.J.; Pennebaker, E.S. (Shell Oil Co., New Orleans). pp N1-N14 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

A quantitative relationship between the conductivities of clean water-bearing sands and nearby shales has been established for the Tertiary formation of offshore Louisiana. From this relationship, the connate water resistivity of the sands can be calculated using the conductivity of the nearby shales. The ability to independently calculate water resistivity is very important, especially where there are no clean water-bearing sands near or adjacent to hydrocarbon-bearing sands. Although empirical, industry-accepted clean and shaly sand petrophysical relationships help explain why this method yields acceptable values. An example is given for the South Marsh Island 130 Field where there is an unusually wide range of formation water resistivities over a depth interval of about 2000 feet (4000 to 6000 feet). This relationship appears statistically accurate for the prediction of sand water resistivities from the nearby shale conductivities.

5173 New approach to carbonate analysis. Nugent, W.H. (Schlumberger Well Services, Abilene, TX); Coates, G.R.; Peebler, R.P. pp O1-O10 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

Water saturations from vuggy or oolicastic carbonates are often over-optimistic. Here we present an empirical but well-established technique that permits confident evaluation of such formations. This method makes use of the fact that sonic logs respond differently to vugs and oolicasts than do the nuclear porosity logs.

5174 Some aspects of the calculation of gypsum-free porosity. Frost, E. Jr. (Dresser Industries, Inc., Houston, TX). pp P1-P23 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

The techniques of using log-derived data in complex lithologies to derive reasonable pictures of the true lithologies are as numerous and varied as the possible combinations of the minerals encountered in the rock itself. This paper will review some of the methods available for identifying and coping with one of these minerals, gypsum, which is sometimes present in a potentially productive reservoir. Some of the more frequently used methods will be discussed in the hope that new insight will be gained into their use in bulk volume mineral calculation. A new method of considering the percent gypsum content and porosity will also be presented. Examples of the usefulness of this new method will be given.

5175 Logging tests in porous media to evaluate the influence of their permeability on acoustic waveforms. Lebreton, F. (Institut Francais du Petrole, Paris); Sarda, J.P.; Trocqueme, F.; Morlier, P. pp Q1-Q26 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

A new acoustic parameter is proposed in view of building a permeability log. First results of actual trials performed in wells are reported. Then methods and results of experiments in artificial porous media are described. This new acoustic parameter seems to be useful for evaluating rock permeability.

5176 Laterolog Groningen Phantom can cost you money. Woodhouse, R. (British Petroleum Co. Ltd., London). pp R1-R17 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

Early Laterolog tools had erroneously high readings below high resistivity beds--this became known as the "Delaware Effect". Shifting the measure current return electrode to surface significantly reduced the problem. The new generation of deep reading Laterolog tools is shown in this paper to be affected by the "GRONINGEN PHANTOM"--a new manifestation of the old Delaware Effect. The Phantom has been observed to a maximum distance of 272 feet (83 metres) below high resistivity beds. The erroneously high resistivity reading of the Phantom is greatest when R/sub t/ is low. Log readings of three times the correct deep Laterolog reading are common. Examples of the Phantom in shale beds, water and hydrocarbon bearing sandstones are presented together with observations in eleven wells. The GRONINGEN PHANTOM costs you money when it leads to unjustified optimism--the setting of a liner and the flow testing of "Phantom Hydrocarbon". It is equally important that actual hydrocarbon bearing zones are not dismissed as Phantoms. Careful consideration must be given to all the evidence in a well and particularly the LLS, micro-resistivity, and neutron/density logs.

5177 Prediction of water saturation and recoverable hydrocarbon volumes in shaly sand reservoirs. Krygowski, D.A. (Cities Serivce Co., Tulsa); Pickett. G.R. pp BB1-BB15 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

Four methods of well log interpretation in shaly sand reservoirs, based on empirically observed relationships, are developed. Three methods are crossplot techniques applicable to single- or multiple- well analysis. The fourth technique, based on statistical methods, requires data from existing wells in order to be applied. The Rwa-SP crossplot method quantifies water saturation values in shaly zones by means of overlays which show the location of water-bearing trends as a function of shaliness, Rmf, and Rw. The resistivity-apparent porosity crossplot method applies correction factors to resistivity and acoustic log measurements to normalize the data to clean sand values. The resistivity-SP crossplot method is used to infer values for water saturation and porosity when no measures of porosity are available in individual wells. The fourth method uses parameters derived from well logs to directly predict recoverable hydrocarbon volumes (in this case, primary ultimate recovery) without the knowledge of specific values of porosity and water saturation.

5178 Log interpretation of shaly formations using the velocity ratio plot. Leeth, R. (Halliburton Co., Denver); Holmes, M. pp CC1-CC9 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

Conventional log analyses in the shaly sandstones of western Colorado are quite difficult because of the very high shale content. Net pay and perforation intervals are often picked from neutron-density overlays after an empirical 8 to 10 porosity unit shift to obtain crossover, in addition to an arbitrary resistivity cut-off. The Velocity Ratio Plot has been applied to three wells in the Mancos "B" formation in an attempt to more accurately delineate productive intervals. This method consists of determining the ratio of compressive to shear velocity, using the Micro-Seismogram along with the Acoustic Velocity Log. Data presented shows that net pay determined from this method more accurately predicts initial flow rates. Long term deliverability calculations were made on the three wells, but such calculations are highly dependent on porosity and water saturation values used.

5179 Evaluation of oil wells by logging methods in the USSR. Laptev, V. (All-Union Research Inst. of Oil Field Geophysics, Moscow). pp EE1-EE10 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

Temperature was the first geophysical parameter to be measured subsurface in Russia. These measurements were first carried out in Bibi-Eibath oil field (Baku) in 1906. But the broad application of geophysical well logging methods began in 1929 in Grozny where for the first time the Schlumberger resistivity logging method was introduced. Since that time the well logging geophysical service has grown up into a powerful branch of the oil industry. It provides with valuable information the most important divisions of the oil industry such as geology, drilling production. Not only the USSR Ministry of Oil Industry, but the Ministry of Geology and Gas Ministry also have their own geophysical enterprises. In this report we shall consider the well logging state of the USSR Oil Industry.

5180 Practical shale compensated chlorine log. Fletcher, J.W.; Walter, J. (NL Industries, Inc., Houston, TX). pp GG1-GG11 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

Since commercial introduction on a limited basis in June 1977, shale compensated chlorine logging (SCCL) tools in $3^1/_2$ and $1^{11}/_{16}$ inch diameters have been run successfully on more than 20 wells along the Louisiana Gulf Coast. This modern neutron-gamma spectral survey has provided accurate, quick-look water saturation measurements through tut ıg and casing, which required substantially no corrections for shaliness or porosity. In this text, SCCL instrumentation and principle of measurement are discussed along with interpretation equations and nomographs. Two selected log examples illustrate the presentation and interpretation of this new cased hole log.

5181 Carbon/oxygen log applications in shaly sand formations contaminated with tuffite minerals. Sacco, E.L. (Dresser Industries, Inc., Buenos Aires). pp HH1-HH11 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

Log evaluation of the oilfields located in the San Jorge basin (Southern Argentina) is one of the most difficult to perform. Shaly sand formations are contaminated with considerable amounts of tuffites. Salinities of formation waters are very low. The Carbon/Oxygen system was introduced during 1976 as an attempt to solve the problem of locating overlooked pay zones behind the casing. This paper describes the results of the first 15 wells logged and how it was necessary to develop a cross-plot technique with the Spectralog in order to solve the complex lithology problem.

5182 High frequency electrometry methods for logging oil and gas wells. Antonov, J.N. (Institut de Geologie et de Geophysique, Novosibirsk, USSR)). pp 11p, Paper 14 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

An analysis of the principal relations between the amplitude and phase of the high frequency electromagnetic field and the electric constants of a homogeneous isotropic medium shows that the amplitude characteristics are more sensitive to the relative dielectric permeability than to the electric conductivity. The phase characteristics of the field can be used to measure the electric conductivity of the medium at frequencies up to 10 million Hertz. In order to determine the type of formation saturation from the electrometry data, the radial heterogeneity in the distribution of resistivities must be studied. This aspect is discussed. (JSR)

5183 Exploration for and evaluation of hydrocarbon resources in cased well boreholes. Fertl, W.H.; Wichmann, P.A. (Dresser Industries, Inc., Houston, TX). pp 18p, Paper 25 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977).

From 5. European logging symposium; Paris, France (20 Oct 1977).

The importance of reservoir porosity data cannot be overemphasized. Modern logging suites give this information. However, in old wells that are now being considered for recompletion attempts and enhanced recovery projects, adequate logs are frequently not available. Similarly, in newly drilled but highly deviated development wells and/or problem holes (e.g., stuck drill pipe, etc.) a complete open hole logging suite cannot always be obtained. Under these circumstances it is frequently still possible to properly evaluate such wells with a suite of cased hole porosity devices. These devices include acoustic, density, and various neutron logs (e.g., conventional single detector and the newer dual detector neutron logs, including the Ratio curve from pulsed neutron logging devices). Cased hole application of pulsed neutron logging devices, supplemented by reliable porosity information, then allows determination of the fluid distribution in reservoir rocks behind casing. In addition, natural gamma ray spectroscopy data, recorded by the Spectralog, provide a

quantitative definition of the three most common sources of natural radioactivity, the uranium and thorium series and potassium-40. This information greatly assists in complex reservoir analysis problems, in the presence of radioactive buildup behind casing under dynamic fluid conditions, in fracture detection, etc. Several field cases are presented to illustrate the application of these logs under specific borehole and reservoir conditions, and to discuss the information obtainable to explore for and/or re-evaluate hydrocarbon sources behind casing.

5184 Geologicheskie osnovy poiskov, razvecki i razrabotki neftyanykh i gazovykh mestorozhdenii. (Geological principles in the exploration, development, and exploitation of petroleum and gas deposits). Permyakov, I.G.; Shevkunov, E.N. Mowcow; Nedra (1976). 377p. (In Russian).

The geological principles in the exploration, development and exploitation of oil and gas deposits are presented to an extent that is essential for engineer-economists of petroleum industries and gas fields. Information is given on general and historical geology, petroleum geology, hydrogeology and stratal physics. Considerable attention is given to a description of geophysical methods of studying boreholes. A detailed description is given of principles of developing petroleum deposits and systems used for the exploitation of characteristic types of petroleum deposits. Attention is given to the planning of petroleum recovery in future planning. The book is designed for students at petroleum institutions of higher learning and departments. It can also be used by engineering-technical personnel in the petroleum industry and associates at scientific-research institutes.

5185 Exploration for fossil and nuclear fuels from orbital altitudes. Short, N.M.; Tiedemann, H.A. (Goddard Space Flight Center, Greenbelt, MD). pp 5.11-5.18 of Proceedings of the twelfth space congress. Cape Canaveral, FL; Canaveral Council of Technical Societies (1975).

From 12. space congress; Cocoa Beach, FL, USA (9 Apr 1975).

Studies of LANDSAT and Skylab-EREP data have defined both the advantages and limitations of space platforms as a new "tool" in mineral exploration. Generally, useful information can be extracted from synoptic imagery and/or the direct measurements of surface reflectances, from which small-scale reconnaissance geologic maps are produced, previous maps are edited and refined, landform types are better evaluated in context, and structural deformations and fracture trends are determined on a regional basis. Information about rock composition, stratigraphic ages, and "telltale" chemical alterations as guides to subsurface deposits are less reliable. When used during the exploration phase, LANDSAT data serve to localize areas for more intensive study by field mapping, geophysical and geochemical methods, and subsurface drilling. By reducing large areas to prime "targets" of maximum likelihood, the LANDSAT overview approach should save a considerable fraction of the exploration costs, and in some instances should assist significantly in making new discoveries.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 5183, 5184, 6453

5186 (UCID—17866) **Environmental impact assessment: enhanced oil recovery by steamflood, Kern County, California.** O'Banion, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Jul 1978. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

DOE has contracted with Chanslor-Western Oil Development to share the cost of a field experiment in oil recovery by steamflooding. The experimental project is organized in two phases. Phase one began in 1975, prior to DOE involvement, and consisted of drilling 14 wells and installing steam generators, pumps, tanks, and steam and water lines; phase two will expand the project to 56 wells and will be located immediately west of phase one in what is now undeveloped, hilly grassland. Phase two, like phase one will require extensive alteration of the steep terrain to provide level wellpads. However, apart from erosion in the event of prolonged rain, extremely rare in this semi-arid climate, the grading should not create any significant impacts nor restrict future uses of the site. No other significant environmental problems are expected to result from the project.

5187 Enhanced oil-recovery field reports. *Enhanced Oil-Rev. Field Rep.;* **4**: No. 2, 237-399(Sep 1978).

Thirty-eight update reports are made on the progress of ongoing field tests of enhanced oil-recovery methods. Ten projects were terminated during this period.

5188 Potassium drilling solution prepared from a magnesium hydrogel. Angelopulo, O.K.; Devyatov, E.V.; Zhuravlev, G.I.; Skvortsov, Yu. A.; Polikarpova, T.P. *Gazov. Prom-st.;* No. 5, 18-21(May 1977). (In Russian).

A description is given of using a potassium drilling solution prepared from a magnesium hydrogel in the drilling of boreholes in the Astakhan anticline. 1 table.

5189 An improved method for producing a broad fraction of light hydrocarbons. Nemkov, V.V.; Gadzhiev, N.G.B.; Bergo, B.G.; Fishman, L.L.; Bakhshiyan, D.Ts.; Razin'kova, V.M.; Zadorozhnyi, V.V. *Gazov. Prom-st.;* No. 5, 21-23(May 1977). (In Russian).

An examination is made of an improved manufacturing arrangement for producing a broad fraction of light hydrocarbons by using new multi-flow disks in the absorption-stripper tower and by feeding a portion of the raw material into the bottom of the tower. Computation results for the process and industrial experiments are presented which indicate the superiority of the proposed production arrangement. 2 tables, 1 illustration.

5190 Destruction of filtration incrustations of aluminate clay solutions. Galyan, D.A.; Tarnavskii, A.P.; Lizogub, G.D. *Gazov. Prom-st.;* No. 5, 27-28(May 1977). (In Russian).

Research results are presented for determining the optimal hydrochemical action time of a buffer fluid (10% NaOH solution) that is needed to destroy filtration incrustations of aluminate clay solutions with respect to the effect of a buffer fluid and an aluminate clay solution on the properties of plugging solutions. Fundamental recommendations are made with respect to using 10% NaOH solutions for removing aluminate clay solution filtration incrustations. 1 table.

5191 Effect of a gas condensate's composition on the foam-forming capability of surfactants. Chashkin, Yu.G.; Kiril'chenko, N.E.; Ternavskii, N.I. *Gazov. Prom-st.;* No. 5, 29-31(May 1977). (In Russian).

Results of laboratory tests are given for determining the effect that the composition of a gas condensate has on foam formation in a stratal water—condensate system. Foam formation in water-condensate mixtures was shown to depend to a large measure on the content of aromatic hydrocarbons in the gas condensate; foam formation worsens as the degree of aromatic hydrocarbon saturation increases. The stability of foams produced in the frothing of water-condensate mixtures also depends on the type of condensate and surfactant. 2 tables, 1 illustration, 3 references.

5192 Injected polymers and control logs in enhanced recovery. Arnaud, J. pp 21p, Paper 26 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

Among the various procedures used to augment the recovery rate of petroleum from formations, the most developed one is polymer flooding proceded or not by a surfactant slug. The most used polymers are partially hydrolyzed polyacrylamides and polysaccharides. The polysaccharides have been improved and can be injected in homogeneous formations of several hundred millidarcys, whatever the degree of salinity of the formation water. Recent progress has made it possible to hope for results in denser formations because of the development of totally refined biopolymers, i.e.; relieved of their cells. During polymer flooding, it is very important to follow the evolution of the fluids in the reservoir in order to control and modify the injection conditions. For this one obtains classical logs complemented by drill core measurements as complete as possible all the physical parameters of the reservoir and of the fluids in it. In order to have available control windows across the formation, tubed holes allowing radioactive measurements (gamma rays and carbon-oxygen logs) can be used. Neutron, sonic, and electric logs also give valuable data.

PROCESSING

REFER ALSO TO CITATION(S) 4966

5193 Hydrocarbon conversion with an acidic multimetallic catalytic composite. Hayes, J.C. (to UOP Inc.). US Patent 4,097,368. 27 Jun 1978. Filed date 18 Oct 1976. 28p.

Hydrocarbons are converted by contacting them at hydrocarbon conversion conditions with an acidic multimetallic catalytic composite comprising a combination of catalytically effective amounts of a platinum group component, a nickel component, a cobalt component, and a halogen component with a porous carrier material. A preferred modifying component for the disclosed catalytic composite is a Group IVA metallic component. The platinum gold, nickel, cobalt and halogen components are present in the multimetallic catalyst in amounts, respectively, calculated on an elemental basis, corresponding to about 0.01 to about 2 wt.% plati-

num group metal, about 0.01 to about 2.5 wt.% nickel, about 0.05 to about 5 wt.% cobalt, and about 0.1 to about 3.5 wt.% halogen. Moreover, these metallic components are uniformly dispersed throughout the porous carrier material in carefully controlled oxidation states such that substantially all of the platinum group metal and nickel are present therein in the elemental metallic state, and substantially all of the catalytically available cobalt component is present in all the elemental metallic state or in a state which is reducible to the elemental metallic state under hydrocarbon conversion conditions or in a mixture of these states. A specific example of the type of hydrocarbon conversion process disclosed is a process for the catalytic reforming of a low-octane gasoline fraction wherein the gasoline fraction and a hydrogen stream are contacted with the acidic multimetallic catalyst disclosed herein at reforming conditions.

5194 Hydrocarbon-feed distributor of injecting hydrocarbon feed. Bartholic, D.B. (to UOP Inc.). US Patent 4,097,243. 27 Jun 1978. Filed date 4 Nov 1976. 10p.

A hydrocarbon-feed distributor for injecting a hydrocarbon feed into contact with a fluidizable catalyst at conversion conditions in the lower end of the riser reactor conduit is described whereby wall temperatures within the conversion zone are reduced and overcracking of the hydrocarbon feed is minimized.

5195 Hydrocracking process and catalyst for production of middle distillate oils. Ward, J.W. (to Union Oil Co. of California). US Patent 4,097,365. 27 Jun 1978. Filed date 28 Mar 1977. 8p.

Heavy mineral oil fractions are selectively hydrocracked to produce mainly middle distillate oils boiling in the 300—700°F range. Certain novel, highly active and selective catalysts are utilized comprising molybdenum and/or tungsten plus nickel and/or cobalt supported upon certain heterogeneous composites of a silica-alumina cogel or copolymer dispersed in a matrix consisting essentially of alumina gel.

5196 Process for removing unfilterable solids from an oil. Bose, P.R. (to Chevron Research Co.). US Patent 4,094,770. 13 Jun 1978. Filed date 22 Jun 1977. 10p.

A process is provided for removing unfilterable suspended solids from an oil wherein these solids are agglomerated to separable conglomerated solids by adding to the oil an agglomerating agent comprising a mixture of acetone and 2-butanone.

5197 Catalytic cracking and dehydrocyclizing of alkanes using alkaline earth oxides promoted with manganese oxide and/or rhenium oxide. Heckelsberg, L.F. (to Phillips Petroleum Co.). US Patent 4,093,536. 6 Jun 1978. Filed date 22 May 1975. 10p.

Alkanes are catalytically converted employing a catalyst comprising at least one alkaline earth oxide together with a promoting amount of manganese oxide and/or rhenium oxide. When the catalyst is treated with an oxygen-containing gas, such as air, prior to contacting the alkanes conversion by cracking is favored. When the catalyst is treated with hydrogen prior to contacting the alkanes dehydrocyclization is favored. A composition of matter is disclosed suitable for use as a catalyst for converting alkanes.

5198 FCC catalyst section control. Gross, B.; Lee, W. (to Mobil Oil Corp.). US Patent 4,093,537. 6 Jun 1978. Filed date 17 Feb 1977. 12p.

In the fluid catalytic cracking process, improved adaptive behavior of the catalyst section with the regenerator operating in the complete CO-burning mode is achieved by including, as elements of control, variable preheat of the air feed and variable recycle of regenerated catalyst to spent catalyst. In response to excursions of the regenerated catalyst temperature, such as would be caused by change of feedstock, the air preheat temperature and recycle ratio are altered in a direction to restore the regenerated catalyst temperature to a predetermined value. The improved control system extends the useful control range, and it also dimishes counteproductive changes in severity induced by disturbances such as change of feedstock quality.

5199 Chemistry of hydrodesulfurization of sulfur heterocyclic compounds. Singhal, G.H.; Espino, R.L. (Exxon Research and Engineering Co., Linden, NJ). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 36-45(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Results of studies are presented on the hydrodesulfurization of sulfur heterocyclics over a sulfided Co--Mo/γ--Al_2O_3 which show that the reaction rates and pathways are strongly dependent on the steric and electronic environments of the sulfur compounds. Thus, in the case of thianthrene and its tetramethyl derivative which have molecular dimensions similar to DBT but have the electron density localized on the sulfur atoms, direct desulfurization via sulfur coordination with the active sites of the catalyst seems to occur. Consequently, the product consists of only aromatic molecules such as benzene and xylene respectively, and none of their hydrogenated derivatives, cyclohexane and 1,4-dimethylcyclohexane. It can also be concluded form this study that aromatic or alkylaromatic compounds, once formed, are not further hydrogenated over this catalyst and under the reaction conditions. On the other hand, for compounds such as DBT and TPT in which the electron density of sulfur is delocalized over the conjugated π system, both hydrogenated aromatic and unhydrogenated products are formed. In the case of dibenzothiophene, the products are cyclohexylbenzene and biphenyl. It is proposed that these compounds are produced from a common intermediate suggestive of parallel paths for the reaction rather than consecutive steps as implied in the literature.

5200 Mechanism of hydrodesulfurization of dibenzothiophene: a kinetic analysis. Espino, R.L.; Sobel, J.E.; Singhal, G.H.; Huff, G.A. Jr. (Exxon Research and Engineering Co., Linden, NJ). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 46-64(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Results are presented of a study conducted to develop an understanding of the mechanisms involved in hydrodesulfurization (HDS) of petroleum. Kinetic models were developed which quantify the routes for desulfurization and hydrogenation of dibenzothiophene (DBT). Hydrodesulfurization of dibenzothiophene to biphenyl, cyclohexylbenzene, and H_2S over a Co--Mo/Al_2O_3 catalyst fits a kinetic model which is included in the text. The model accounts for the observation by Rollman that the production of cyclohexylbenzene (CHB) increases with temperature. The proposed mechanism also accounts for the product distribution reported by Bartsch and Tanielian who found only H_2S and biphenyl (BiPh) at atmospheric pressure. The model predicts a product ratio, [CHB]/[BiPh], of 0.09 at 325°C and 3.1 MPa and a ratio of 0.005 atmospheric pressure. The rate for DBT disappearance is described best by an included Langmuir--Hinshelwood expression. This expression becomes first order with respect to DBT as its concentration decreases. This accounts for the first order dependence observed by Houalla, et al. at the low DBT concentration they studied. The rate expression implies that the surface reaction involves two sites on the catalyst surface, one site on which DBT and products competively adsorb and a second site for H_2 adsorption. This concept of two sites is further established by studies in which the addition of H_2S decreased the rate of conversion but did not affect product selectivity. The competitive adsorption by more than one reaction product can be deduced from the ratio of absorption coefficients KDBT/K products which indicates that more than one product contributes to K products. The kinetic models developed to account for product selectivity and rate of DBT disappearance support the reaction mechanisms proposed in an earlier paper on the chemistry of condensed sulfur heterocyclics.

5201 Characterization of supported molybdena catalysts via vibrational spectroscopy. Brown, F.R.; Tischer, R.; Makovsky, L.E.; Rhee, K.H. (Pittsburgh Energy Research Center). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 65-79(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The molecular structural features of several alumina supported molybdena and cobalt catalysts were studied by analysis of their Raman spectra. It was found that as the amount of cobalt added is increased, the external layer spectra show decreasing amounts of molybdenum which have not interacted with the cobalt, while the internal layer spectra show increasing amounts of cobalt which have not reacted with molybdenum (Co_3O_4). These spectral results show how Raman spectroscopy can be used to characterize supported molybdena catalysts. While additional research is necessary to more completely define the exact nature of these types of catalysts, certain aspects of the various structural theories for the catalysts are now supported by these Raman data. Since molybdena catalysts become sulfided while being used as hydrodesulfurization catalysts, the structural characterization of sulfided catalysts is, from a practical standpoint, more important. Studies of sulfided catalysts are now in progress.

5202 Correlation of ESCA binding energy shifts with changes in zeolite structure and cations. Barr, T.L. (UOP Inc., Des Plaines, IL). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 82-92(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Zeolites used in the petroleum industry were studied by removing their charge shifts leaving an unusual binding energy shift which distinguishes various zeolitic members. It was found that there are characteristic shifts in the binding energies of all of the constituents of the zeolites examined. These shifts seem to follow a definite pattern relatable to the structural or cation changes in these (sodalite containing) zeolites. Thus, the different binding energies

represent either structural or cation shifts and they differentiate between the X and A systems. Since the binding energies of all of the constituents shift in the same direction, thse shifts cannot simply be classified as traditional chemical shifts. Since the electron flood gun has been employed to remove the macroscopic charge shift from these insulating materials, the shifts are not charge shifts, even though they produce a similar pattern. The pattern followed is a shift to higher binding energy for all of the constituents as the size of the cage, cation charge and the Si/Al ratio increases. The shifting pattern, thus, seems to follow the change in the electrostatic charge fields calculated by Dempsey. The line widths for all of the principal peaks for bivalent systems are broader than those for NaA and NaX. However, the line widths for the mixed valent cation species are also generally broader than those for bivalent only species.

5203 Stabilization of hydrocracked lubricating oils. Yan, T.Y. (Mobil Research and Development Corp., Princeton, NJ). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 113-119(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Research directed to finding an effective and less expensive method for stabilizing hydrocracked lubricating oils is reported. It is noted that hydrocracked lubricating oils are unstable and form sediment upon exposure to light and air. These unstable oils can be made indefinitely stable by treatment with olefins over acidic catalysts. The reaction involved in this treatment is aromatic alkylation, possibly including the reactive materials in the oil. Acidic catalysts are effective for this reaction, particularly those with moderate acid strength, such as montmorillonite and acidic resins. Of the olefins tested, the larger olefins are more effective alkylating agents. Hydrocracked oils of lighter (lower viscosity) grades are less stable and more difficult to stabilize via alkylation. Olefin cconcentration in the feed is the most critical parameter, and the quantity 5 to 10 times in excess of the olefin consumption is required to assure stable products.

5204 Types of coke formed during the pyrolysis of light hydrocarbons. Albright, L.F.; McConnell, C.F.; Welther, K. (Purdue Univ., West Lafayette, IN). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 183-196(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

An investigation was conducted to determine if filament type coke is formed at Incoloy 800 and aluminized Incoloy 800 surfaces during pyrolysis of light hydrocarbons. Scanning electron microscopic pictures were obtained and analyses of the metal were made. It is noted that the results are of interest, however they raise more questions than are answered. (JRD)

5205 Gradientless reactors for process kinetic studies and catalyst testing. Robinson, K.K.; Mahoney, J.A. (Amoco Oil Co., Naperville, IL). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 351-360(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

A program is described devoted to the design of a bench-scale catalytic reactor to operate at commercial petroleum processing conditions and also eliminate the effect of external heat and mass transfer on the reaction rates. To satisfy this requirement each catalyst particle inside the reactor must be surrounded by a vapor at the same temperature and composition with film gradients around the pellet eliminated. Also, the physical environment around the catalyst particle must approach that in a full-scale commercial reactor. Descriptions are given of two gradientless reactors which have been developed in the program to satisfy needs for both vapor phase and multiphase reactions systems. Both types of reactors have performed effectively and generated data unclouded by concentration or temperature gradients.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 5051, 6091, 6355, 6360, 6361, 6362

5206 Thermal cracking of light gas oil at high severity to ethylene. McKinney, J.D.; Sebulsky, R.T.; Wynne, F.E. Jr. (to Gulf Research and Development Co.). US Patent 4,097,363. 27 Jun 1978. Filed date 12 Jul 1976. 16p.

A process for thermal cracking of petroleum light gas oil to produce a product including ethylene comprises passing said oil, a diluent gas and entrained hot solids through a cracking zone at a temperature between 1,300 and 2,500°F at a relatively high cracking severity corresponding to a methane yield of at least 12 weight percent based on hydrocarbon feed oil and with a weight ratio of diluent gas to feed oil of at least 0.3. A naphtha feedstock can be separately cracked at a lower severity using a lower weight ratio of diluent gas to feed oil, with the inert solids from both cracking zones being sent to a common burner whose fuel comprises heavy oil product from both cracking zones.

5207 Pyrolysis of alpha-olefins: a mechanistic study. Rebick, C. (Exxon Research and Engineering Co., Linden, NJ). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 142-153(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The pyrolysis of several longer chain α-olefins are examined and a general cracking mechanism is derived from product distributions. Investigation results show that pyrolysis of an alpha-olefin gives a product distribution significantly more complicated than that of the corresponding paraffin. The nature of the distribution suggests the existence of competing decomposition paths. It is postulated that three main paths exist--a molecular decomposition involving a six-membered ring transition state which yields propylene and an alpha olefin with three less carbon atoms than the reactant, and two free radical chain pathways. One free radical channel involves hydrogen abstraction from, the other radical addition to the reactant olefin. A linear combination of these three paths gives reasonable agreement with experimental data.

5208 Production of electrode binder pitch from petroleum based materials. Pease, E.C.; Logan, A. (Gulf Oil Canada Ltd., Sheridan Park, Ontario). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 197-207(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The pyrolysis of decant oil to produce pitch for electrode binding material is described. Equipment and Procedures are described along with pyrolysis products and kinetics of coke formation. (JRD)

5209 Deposition and gasification of coke during ethane pyrolysis. Albright, L.F.; McConnell, C.F. (Purdue Univ., West Lafayette, IN). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 225-240(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Ethane was pyrolyzed at conditions of commercial interest in several tubular reactors. Information has been obtained that provides further insights on the coke precursors, rate of formation of coke, rate of gasification as the coke reacts with steam, and photographs of the coke and resulting metal surfaces as obtained by a scanning electron microscope. Tubular reactors employed were constructed from Incoloy 800, stainless steel 304, stainless steel 410, Hastelloy X, and Vycor glass. Results indicate that both deposition and gasification depend in some complex manner on the surface composition. The present investigation indicates that important information can be obtained with the scanning electron microscope.

5210 Investigation of petroleum residue sulfornation in the utilization of sulfuric acid wastes. Basyrova, R.Sh.; Galiakbarov, M.F. *Khim. Tekhnol. Topliv Masel;* No. 3, 30-32(1977). (In Russian).

Thermal reduction processing of sulfuric acid by-products, whose utilization constitutes a vital problem, is developed and introduced. The sulfonation of asphalt by waste sulfuric acid is studied from an alkylation unit at 30°, 50°, 80°, 100°, 130°, and at various ratios. The sulfuric acid sulfonation of asphalt is shown to proceed up to the ratio asphalt: H_2SO_4 = 100 : 20. A further increase in acid leads to an increase in its free state. Basic changes in the asphalt composition also occur up to the ratio asphalt: H_2SO_4 = 100 : 20. An increase in the sulfonation temperature leads to an increase in the maximum decomposition temperature of sulphur compounds.

5211 Effectiveness of ionol—antioxidant additive to jet fuels in heightened temperature. Gureev, A.A.; Chertkova, N.Ya. *Khim. Tekhnol. Topliv Masel;* No. 6, 9-12(1977). (In Russian).

A study was made of ionol properties as an antioxidant additive to jet fuels of variable chemical composition. The fuels were oxidized by atmospheric oxygen under identical conditions and the oxygen concentration was kept constant. The formation of a precipitate, which is characteristic of straight-run distillation fuels, was shown to be prevented in concentrations of 0.05 to 0.1 wt %. The formation of oxidation products dissolved in hydro-purifed fuels can be completely prevented during the oxidation of those fuels.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 5158, 6090, 6134

WASTE MANAGEMENT

5212 Process for reclaiming used hydrocarbon oils. Ebel, E.; Kobel, H.R.; Widmer, E. (to Adolf Schmids Erben AG). US Patent 4,097,369. 27 Jun 1978. Priority date 28 Feb 1975, German, Federal Republic of (F.R. Germany). 12p.

A process is given for reclaiming used hydrocarbon oils through prepurification by means of coagulation, adsorption, filtration, distillation, and after-treatment, wherein said oils are prepurified and then dehalogenated, fractionally distilled and hydrogenated. It is preferred that for the prepurification said coagulation and said adsorption are carried out by means of a hydroxide or hydroxide mixture, preferably aluminium and/or ferric hydroxide in a proportion of 0.5--5.0% by weight, preferably 1--2% by weight, of hydroxide relative to said used oil at a reaction temperature of from 20° to 200°C, preferably from 50 to 150° C, said hydroxide or hydroxides being produced directly in siad used oil in the presence of water or being introduced into said used oil in the form of an aqueous slurry. It is also preferred that the dehalogenation and accompanying desulfurization are carried out through treatment of said oil with an alkali metal, especially Na or K, an alkaline earth metal, especially Mg or Ca, an alkali, alkaline earth or aluminum alcoholate, an alkali hydride or amide, an organic base, especially pyridine or piperidine, or with metallic aluminum or anhydrous aluminium chloride, in a proportion of the respective treatment agent of from 1 to 2000 moles per metric ton of said oil in the absence of air and humidity at a reaction temperature of from 15° to 300°C.

5213 Method for treatment of oil-containing waste water by using an oil adsorbent. Noguchi, K.; Yoshimura, K.; Tanaka, H.; Hayashi, M. (to Koa Oil Co., Ltd.). US Patent 4,094,776. 13 Jun 1978. Priority date 6 Oct 1975, Japan. 14p.

An effective and regenerable oil adsorbent is obtained from a pitch-like substance formed by heat-treating a heavy hydrocarbon oil to such an extent that the volatile matter content thereof is about 10% by weight to about 60% by weight, perferably about 30 to about 50% by weight. By using this oil adsorbent, oil-removing purification treatment of oil-contaminated water can be effectively achieved with economical advantages.

5214 Liquid phase catalytic oxidation of waste water. Farha, F.E.; Box, E.O. Jr.; Dunn, R.O.; Kuerston, R.D. (Phillips Petroleum Co., Bartlesville, OK). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 93-100(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Development of proprietary catalysts to purify waste water generated by the petroleum and petrochemical industries is reported. A liquid phase catalytic oxidation process has been developed as a viable waste water treatment process. Oxidation catalysts have been developed which exhibit good organics removal capability, over 90% contaminants removal, and a life of one year or longer. Process design and economic evaluations indicate that this waste water treatment process is economically sound. Reactor systems can be operated in either trickle-bed or upflow configurations using air or oxygen. Catalyst activity was stabilized and life was extended by maintaining an alkali metal content of about 35 mg/l in the feed. This level may be altered, depending upon the pH of the waste water being treated. Operating the reactors at 520°F also increases catalyst life. Organics removal in the two systems, upflow and trickle-bed, are comparable despite somewhat different mass transfer conditions.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 5219, 6632, 6749, 6801

5215 (BNWL-SA—6559) **Recruitment of benthic animals as a function of petroleum hydrocarbon concentrations in the sediment.** Anderson, J.W.; Riley, R.G.; Bean, R.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1977. Contract EY-76-C-06-1830. 47p. (CONF-7710169—1). Dep. NTIS, PC A03/MF A01.

From Symposium on oil/environment; Halifax, MS, USA (11 Oct 1977).

Three separate field installations, consisting of clean and oiled sediment in fiberglass trays, were placed in the intertidal zone of Sequim Bay, Washington to determine rates of hydrocarbon depuration and recruitment of benthic organisms. Detailed chemical analysis, using glass capillary gas chromatography, and GC/MS, were conducted such that individual components and hydrocarbon classes associated with the sediment after varying periods of field depuration could be quantitated. Depuration rates of hydrocarbon types in sediment receiving oil on the surface decreased in the order of saturates, methylnaphthalenes and methylphenanthrenes. The time to 50% depuration (half-time) for these coarse sediments was approximately 100 days, while sediment mixed with oil had only decreased by about 20 to 30% by 100 days. Levels of the aromatics (naphthalenes and phenanthrenes) in the two systems followed the general pattern, but very little loss was exhibited when oil was mixed with sediment. No substantial inhibition of benthic organism recruitment was produced by either type of sediment contamination. There was a tendency for suppression of populations of mature and juvenile bivalves (Mysella tumida) at the last sampling interval for all three installations. Future sampling of these populations and further analyses of all benthic organisms may provide a better evaluation of effects of specific hydrocarbon components in sediments on benthic recruitment. These results are discussed in light of oil spill studies and other field experiments.

5216 (NP—23250) **Final environmental impact statement. Crude oil transportation system: Valdez, Alaska to Midland, Texas (as proposed by SOHIO Transportation Company). Executive summary.** Berklund, C. (Bureau of Land Management, Washington, DC (USA)). 1977. 164p. Bureau of Land Management, Washington, DC.

SOHIO Transportation Company of California, a subsidiary of The Standard Oil Company of Ohio, has filed applications with the U.S. Department of the Interior and several other Federal agencies for permits and certificates necessary to construct and to operate a crude oil transportation system between Valdez, Alaska, and Midland, Texas, using Long Beach, California, as the West Coast port of entry. An environmental impact statement is presented which sets out facts about the proposed SOHIO crude oil transportation project, and environmental consequences of that project, in sufficient detail to provide information to the public and to assist in decision making. The proposal and the environment are described and chapters are included on environmental impacts, mitigating measures, alternatives, and consultation with others. (JRD)

5217 Matching an oil spill with its source requires methods that take into account the weathering of oil in the spill. Bentz, A.P. (Coast Guard, Groton, CT). *Anal. Chem.;* **50**: No. 7, 655A-658A(Jun 1978).

The analytical approach to the identification of the source of an oil spill is discussed. Since the identification of the source of an oil spill requires a forensic chemical analysis, several different types of analyses are used, namely, thin-layer chromatography, gas chromatography, liquid chromatography, low-temperature luminescence, infrared spectroscopy, and emission spectroscopy. The application of these methods to the process of proving or disproving the source of an oil spill is described with specific examples. Special sampling devices and special equipment for studying weathering effects on the validity of the methods are described.

5218 United States Department of the Interior final environmental impact statement. Volume 2. Proposed 1978 Outer Continental Shelf oil and gas lease shale, offshore Eastern Gulf of Mexico, OCS sale No. 65. Washington, DC; Bureau of Land Management (1978). vp.

Volume 2 comprises maps of the lease areas showing the status of bathymetric mapping, distribution of coral reefs, recreational and cultural features, major public areas, geologic features, bottom sediments, vegetation, endangered wildlife, fisheries, land use, infrastructure, and undersea features. (JRD)

POLICY, LEGISLATION, AND REGULATION

5219 (TID—28622) **Environmental assessment of the exemption of motor gasoline from the mandatory allocation and price regulations.** (Department of Energy, Washington, DC (USA). Office of Regulations and Emergency Planning). May 1978. 35p. Dep. NTIS, PC A03/MF A01.

It is concluded that the removal of price controls should have: no significant effect on price or supply of motor gasoline, no effect on supply of other products, neither a beneficial nor adverse impact on water quality, no likely impact on air quality, and no significant socioeconomic impacts. Alternative actions are also assessed and rejected. (DLC)

PROPERTIES

REFER ALSO TO CITATION(S) 5210, 6312

5220 Study of the molecular structure of the distillate component of a petroleum binder. Yakimenko, E.V.; Veselovskaya, L.F.; Vinnikova, R.A.; Levin, I.S.; Chugainova, E.A. *Khim. Tekhnol. Topliv Masel;* No. 6, 20-22(1977). (In Russian).

Study results are presented for narrow fractions and groups of polycyclic aromatic compounds of the distillate component of a petroleum binder. The degree of aromatic ring substitution was shown to increase and the content of polycyclic point is increased.

The length of the paraffin chains is subsequently decreased. 2 illustrations, 10 references.

5221 Sulfided Co—Mo/γ-Al_2O_3 catalyst: evidence of structural changes during hydrodesulfurization of dibenzothiophene. Broderick, D.H.; Schuit, G.C.A.; Gates, B.C. (Univ. of Delaware, Newark). *J. Catal.;* **54**: No. 1, 94-97(Aug 1978).

Hydrodesulfurization (HDS) kinetics data for dibenzothiophene (DBT) were measured to characterize the Co-Mo/γ-Al_2O_3 catalyst operating at 100 atm and 300°C. The data indicate that H_2S does more than just inhibit the HDS reaction by adsorbing on catalytic sites in competition with DBT. It is presumed that an increase in space velocity reduced the H_2S concentration produced in the rxn, and resulted in structural changes in the catalyst to reduce the number of catalytic sites. The loss of catalytic sites was not completely reversed when the concentration of H_2S was again increased by decreasing the space velocity. Further data suggested that there is an optimum concentration of H_2S corresponding to a catalyst structure that has a maximum HDS activity. Data from experiments carried out to define the optimum concentration of H_2S led to the conclusion that the catalyst achieved a time-invariant activity which is dependent on the reactor start-up procedure and probably on the presulfiding procedure as well. In light of these data, it is suggested that the catalyst may consist of a range of intermediate structures which could be interconverted by local redistributions of Co and Mo ions accompanied by changes in the Mo-S surrounding.

5222 Energy dispersive x-ray fluorescence spectrometric determination of trace elements in oil samples. Kubo, H. (Univ. of Colorado, Boulder); Bernthal, R.; Wildeman, T.R. *Anal. Chem.;* **50**: No. 7, 899-903(Jun 1978).

A method is described for the determination of trace elements in petroleum by energy dispersive x-ray fluorescence spectrometry. Minimum sample preparation is required. This is achieved by making small targets and spiking the sample with a solution of Cr and Rh in H_2SO_4 or organo-Rh in mineral oil. Use of two spiking elements with different x-ray energies facilitates the determination of x-ray absorption corrections. In the NBS fuel oil (SRM 1634), V, Fe, Ni, and Mo were detected and the results of the analyses correspond well with the NBS certified values. In the shale oil, Fe, Ni, Zn, As, and Se were detected. The one-element spiking method works well for samples of low viscosity where the sample can be spread on the supporting foil thin enough so that the absorption of measured x-rays can be ignored, whereas the two-element spike is needed for high viscosity samples (NBS fuel oil) where samples cannot be made thin enough to ignore sample absorption.

5223 Device for evaluating the thermal stability and corrosive activity of jet fuels under dynamic conditions. Aliev, A.A.; Kochelaev, P.I.; Mardanov, M.A. *Khim. Tekhnol. Topliv Masel;* No. 6, 51-54(1977). (In Russian).

A diagram of a new device TSD-70 is described. In tests the new device uses three times less of the fuel under study than does the American S SFC device. The basic technical specifications of the TCD-70 instrument are presented as well as results which indicate its potential and sensitivity. 1 table, 3 illustrations, 10 references.

COMBUSTION

REFER ALSO TO CITATION(S) 5055, 5134, 5138, 5710

5224 Improving a smelting furnace burner with a loop flare. Merenzon, A.A.; Shklyar, M.S.; Chebotarev, R.I.; Bedratyi, B.A.; Fridman, B.A. *Gazov. Prom-st.;* No. 5, 54-56(May 1977). (In Russian).

Research results are cited for the operation of gas-fuel oil burners of reverberatory furnaces for the smelting of bronze with a loop flare movement. Productivity and fuel consumption were shown to depend on the amount of flare movement in the burner's outlet section. A burner is suggested which has improved external mixture-formation conditions and a mobility which is increased twofold. Results are given for intensifying fuel combustion by using compressed air. 1 table, 3 illustrations.

NATURAL GAS

REFER ALSO TO CITATION(S) 4941, 5156, 6084

5225 Gas industry's views on the nation's energy research and development needs. Lawrence, G.H. (American Gas Association, Arlington, VA). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 361-367(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The research and development programs needed in the natural gas and chemical industries are reviewed. Discussions are included on natural gas potentials and sources, geopressured resources, synthetic gas from biomass, and coal gasification. (JRD)

5226 Resourceology: a new direction in natural gas geology. Istomin, A.N. *Gazov. Prom-st.;* No. 5, 11-14(May 1977). (In Russian).

A new area of study, resourseology, has been presently coined in natural gas geology. Instead of the traditional geological approach, this new direction solves problems in the evaluation of predictable gas reserves, gas reserve survey and exploration, the planning and long-range forecasting of gas reserve preparations by systems analysis and mathematical simulation. This makes it possible to formulate problems about planning computation automation in this as well as related areas in industry. The transition to a system of automated planning computation promises large economic benefits for the gas industry as a whole. 2 illustrations, 10 references.

RESERVES

REFER ALSO TO CITATION(S) 5151, 5157

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 5161, 5165, 5166, 5178, 5179, 5180, 5182, 5184, 5185, 6819, 6833

5227 (NVO—0655-109) **Western Gas Sands Project status report.** Atkinson, C.H. (CER Corp., Las Vegas, NV (USA)). 30 Jun 1978. Contract EY-76-C-08-0655. 83p. Dep. NTIS, PC A05/MF A01.

A summary is presented of the progress of government sponsored projects undertaken to increase gas production from low permeability gas sands of the western United States during May, 1978. Background information is given in the September 1977 Status Report, NVO/0655-100. The Department of Energy's (DOE) Nevada Operations Office (NVO), is finalizing a Request for Proposal (RFP) covering Technical and Administrative Support for the Project Manager for FY79. C. H. Atkinson, the Western Gas Sands Project (WGSP) Manager, was an observer of the third MHF treatment of Mobil Research and Development Corporation's well No. F-31-136. The fracture was performed on May 10, 1978. R. L. Mann of CER Corporation, met with Dr. Steve Holditch of Texas A and M University to discuss the utilization of the PDP 11/10 computer to be installed in the Mobile Well Test Facility. The USGS is continuing geological and geophysical studies in the four primary study areas. Two flights were made in preparation for low-level olique photography. The Bartlesville Energy Research Center (BERC) and participating National Laboratories, funded by DOE, are continuing their work in the area of research and development. The emphasis is on the development of new tools and instrumentation systems, rock mechanics, mathematical modeling, and data analysis. Mitchell Energy Corporation, Houston, Texas was awarded DOE Contract EF-78-C-08-1547 on March 15, 1978. Field work under this contract is scheduled to begin in July, 1978, with the drilling of a new well.

5228 (NVO—0655-110) **Western gas sands project: status report.** (CER Corp., Las Vegas, NV (USA)). 31 Jul 1978. Contract EY-76-C-08-0655. 93p. Dep. NTIS, PC A05/MF A01.

This report summarizes the progress of government sponsored projects undertaken to increase gas production from low-permeability gas sands of the western United States during June, 1978. Background information is given in the September 1977 Status Report, NVO/0655-100. USGS is continuing geological and geophysical studies to characterize the resource base in the four primary study areas. Field work is under way at the following locations: Western Green River Basin, Sand Wash Basin, Central Montana, Southern Piceance Basin, and Uinta Basin near Price, Utah. The DOE funded National Laboratories are continuing their work directed toward the development of mathematical models, new tools and instrumentation systems, data analysis, and rock mechanics. Active field tests and demonstrations continue in the Piceance and Uinta Basins. CIGE Well No. 2 was fractured on June 22, 1978 with 170,500 lb sand and 203,000 gal of gel. 42 figures, 3 tables.

5229 Estimation of formation pressures in clean gas sands from the dual-spacing TDT log. Blackburn, J.S. (Schlumberger Well Services, Lafayette, LA); Brimage, R.C. pp V1-V14 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

An empirical technique is described in which the data from Dual-Spacing TDT logs are being used to estimate formation pressures in cased holes in south Louisiana. It employs the near- and far-detector count rates, and porosity and saturation data, to estimate Σ/ sub g/ (macroscopic thermal-neutron-capture cross section of the gas), and therefrom to obtain information about formation pressures in clean gas sands in pressure-depletion reservoirs. Log examples will be shown which indicate that, under favorable conditions (i.e., clean sands, light, dry gas, bulk-volume fraction of formation liquids known, and proper hole conditions), it is possible to estimate the formation pressures in south Louisiana wells within about 10 to 15 percent error.

5230 Evaluation of very low-porosity carbonates (Malossa, Italy). Suau, J. (Schlumberger Inland Services, London); Roccabianca, R.; Cigni, M.; Boyeldieu, C.; Spila, M. pp W1-W23 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

Evaluation of very-low-porosity carbonates as found in Malossa is difficult because the porosities are very often nearly the same as the resolutions of conventional logs. Special care must therefore be taken during both data-acquisition and data-processing stages in order to obtain reliable evaluations. As discussed in this paper, random errors can be eliminated by a suitable logging procedure whereas systematic errors have to be compensated for by carefully normalizing log data with respect to a fixed geological model. A formation-factor formula well adapted to the Malossa dolomites is proposed.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 4990, 5184, 5188, 5190, 6453

5231 (NP—23362) **Opportunities for increasing natural gas production in the near term. Volume I. The Tiger Shoal field. Interim report.** (National Academy of Sciences, Washington, DC (USA)). 1977. 106p. National Academy of Sciences, Washington, DC.

Results of studies directed to increasing production in the Tiger Shoal and natural gas field in the Gulf of Mexico are presented. The average production of gas from the Tiger Shoal field in 1976 was 445 million cubic feet per day (MMcf). Without adding to existing facilities or drilling additional wells, gas production from this field could be increased by approximately 129 MMcf/day simply by restoring higher rates in six reservoirs. With additional investment in wells and production facilities, near-term production of gas can be increased beyond this level. For example, production from this field can be increased so that the average daily delivery in the four-year period 1978-1981 could be 18 percent higher than that in 1976. The investment required to achieve this level of production is estimated to be $46.8 million. The maximum economic rate for the producer to operate the field does not vary significantly over a range of discount rates. In all cases studied, the net present worth of future revenues from accelerated production would be increased. Proved reserves have been estimated using standard definitions and original well and reservoir data contained in the files of the U.S. Geological Survey. The model used indicates that the amount of proved reserves remaining in the Tiger Shoal field at this stage in its development is not dependent on the price of gas. Production from Tiger Shoal is expected to start a decline within two or three years under any plan of development; its present expected life of about 20 years would be halved by accelerating production. A decision to accelerate gas production from Tiger Shoal should involve consideration of federal lease terms, the existing contracts with the two interstate pipeline companies serving the field, and the regulatory process for utility operations. These issues, and others, are identified but not examined in detail.

5232 Method for the purification of natural gas having a high content of acidic gases. Pagani, G.; Guerreri, G.; Peri, B. (to Snamprogetti, S.p.A.). US Patent 4,097,250. 27 Jun 1978. Priority date 5 Mar 1976, Italy. 4p.

A method is disclosed for removing acidic gaseous components from natural gases, this method comprising an initial desulfurization stage employing a selective solvent, then removing carbon dioxide by low temperature distillation, the carbon dioxide providing the cooling effect required for such a condensation, recovering the solvent, absorbing the residual carbon dioxide with the regenerated solvent and recycling the CO_2-laden solvent to the desulfurization stage.

5233 Drying gas by injecting highly concentrated glycol. Lebedev, V.M.; Rossolovakaya, S.G.; Sosunov, L.N. *Gazov. Prom-st.;* No. 5, 23-24(May 1977). (In Russian).

An examination is made of a jet spray device for spraying highly concentrated glycol during the drying of natural gas at the Peschano-Umetskii and Stepnovskii underground gas reservoirs. A description is given of the spraying device's design and the engineering system of gas drying. 1 illustration.

5234 Effect of residual water saturation on the accuracy of evaluating reserves. Petrenko, V.I.; Kravtsov, N.A. *Gazov. Prom-st.;* No. 5, 25-27(May 1977). (In Russian).

Eocene layer collectors of the Kanev Field possess a high degree of residual water saturation (62 to 68%). This results in the recovery of residual water along with gas during the operation of gas wells, which is controlled by a hydrochemical methods. The removal of the residual water causes an increase in the gas saturation coefficient of the interstitial space in the drainage zone which decreases the gas reserve factor in the relationship of p/sub t/ = p/ sub t/ (Qg) with respect to the gas system curve. 1 table, 2 illustrations.

5235 Effect of a throttle gas's liquid phase on temperature in a separator. Boichenko, I.G.; Tikhnenko, B.N. *Gazov. Prom-st.;* No. 5, 49-50(May 1977). (In Russian).

The actual temperature in a separator was shown to be different from the computed one when natural gas is separated at low temperatures under industrial conditions. This discrepancy is explained by the presence of a liquid phase in the throttle gas and condensation from a portion of the water and hydrocarbons from the gas phase. A formula is given for estimating the temperature in the separator that can be used when designing industrial low-temperature equipment. 2 illustrations, 2 references.

5236 An analytical method for computing the statics in the glycol drying of gas. Kasperovich, A.G.; Gukhman, L.M. *Gazov. Prom-st.;* No. 5, 51-52(May 1977). (In Russian).

On the basis of experimental studies carried out on a specially constructed instrument, an examination was made of the glycol drying of gas, and gas-liquid phase equilibria were processed from the viewpoint of thermodynamics. A method was worked out for the analytical computation of the humidity content of natural gas in equilibrium with glycol solutions at various contact pressures and temperatures. 1 illustration, 3 references.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 5008, 5231

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 5218

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

5237 Increasing the clay dissolving capability of a buffer-regulated mud acid. Lybarger, J.H.; Richardson, E.A.; Scheuerman, R.F.; Templeton, C.C. (to Shell Oil Co.). US Patent 4,090,563. 23 May 1978. Filed date 27 Dec 1976. 8p.

The clay dissolving capability of an aqueous mud acid solution of weak acid, weak acid salt and fluoride salt (of the type described in the E. A. Richardson U.S. Pat. No. 3,889,753) can be increased by including in the solution a partial salt of an aminopolyacetic acid chelating or complex-forming agent.

POLICY, LEGISLATION, AND REGULATION

5238 (DOE/FERC—0019) **Commission staff reports: impact of 1978—1979 winter curtailment for twenty-nine pipeline companies.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Pipeline and Producer Regulation). 18 Sep 1978. 228p. Dep. NTIS, PC A11/MF A01.

Results of the Federal Energy Regulatory Commission (Commission) staff's survey are reported on short-term natural gas curtailment impacts as projected for the forthcoming winter heating season; November 1978, through March 1979, by interstate pipelines and their customers. Data are tabulated on estimated and actual gas supplies available, emergency gas transactions, weather, and potential availability of emergency gas. (JRD)

TRANSPORT, PIPELINES, AND HANDLING

5239 (ANL/EES-TM—18) **Technology characterization: high Btu gas transmission.** (Sargent and Lundy, Chicago, IL (USA)). Apr 1977. Contract W-31-109-ENG-38. 80p. Dep. NTIS, PC A05/MF A01.

A technology characterization for high Btu gas transmission was prepared. The scope of work was confined to a literature review. The work was divided into four specific areas as follows: (1) a summary of pertinent information from the environmental report of the Great Lakes Gas Company for a 365-mile high pressure pipeline serving American Natural Gas Company's proposed lignite gasification plant in North Dakota; (2) statistical information concerning the operation of the existing United States natural gas transmission pipeline network; (3) a summary of pertinent information from the environmental impact statement of the United States Department of Interior for the proposed 1,619-mile Northern Border Pipeline from Morgan, Montana to Delmont, Pennsylvania; and (4) a summary of pertinent information from the environmental impact statement of the Federal Power Commission for a proposed El Paso Natural Gas Company 418-mile pipeline within the State of Texas which was to be constructed in response to the displacement of natural gas by Liquefied Natural Gas (LNG) importation on the East Coast.

5240 **Calculation of gas fluctuations in a pipeline by the electrical modeling method.** Dobrozhanov, V.I.; Bashlykov, V.A.; Bochkarev, E.B.; Petrov, V.V.; Shkaryabkin, A.P. *Gazov. Prom-st.;* No. 5, 47-48(May 1977). (In Russian).

Results were demonstrated for the electrical simulation of the pipeline system of a propane refrigerator at the Orenburg Gas Reprocessing Plant. Computations are presented for the resonance portion of the contours of a pipeline's electrical analog. Recommendations are made which will make it possible to eliminate pumpage on the equipment under study. 1 table, 1 illustration.

5241 **Use of three-stage gas compression in operating gas main systems.** Leiman, P.P. *Gazov. Prom-st.;* No. 5, 48-49(May 1977). (In Russian).

A three-stage gas compression method is suggested for use at compressor stations to increase the productivity of currently operating gas lines. A comparison is made between the Ukhta-Torzhok gas line technical-economic characteristics in planned (two-stage) and three-stage compression systems with variable cost factors for pipe and gas-pumping units. 1 table.

5242 **Fastening arrangement for sealing barrier in insulating wall of insulated compartment built into a ship's hull.** (to Gaz Transport). US Patent 3,990,382. 9 Nov 1976. vp.

Gaz Transport's new approach attaches integrated LNG cargo tanks to a ship's hull by means of fasteners that can move to allow for the deformation of the ship in response to the effect of waves. Consisting of elongated studs, the fasteners connect one part of the supports of parallel metallic bars (between which are located boxes of the primary insulating barrier) and the double hull. This method eliminates the previous need for planks and makes it possible to use uniform-size boxes throughout the secondary insulating barrier. In the approach, these fasteners are located from point to point along a line corresponding to the median line of the planks previously used. The boxes of the secondary sealing barrier may then be positioned so that the longitudinal median line of a row of boxes is in alignment with the line along which the fasteners replacing the planks are located.

PROPERTIES

5243 **Modification of thermal alkylation with HCl.** Lyon, R.K.; Mitchell, J.E. (Exxon Research and Engineering Co., Linden, NJ). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 154-158(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Thermal alkylation of ethylene in the presence of HCl was studied. The bulk of the alkylation experiments was done using methane as an internal standard. Preliminary experiments showed that the ethylene/isobutane alkylation reaction did not produce observable product methane. Further if the reasonable assumption is made that the percent of the methane internal standard which might be lost via alkylation to propane would be less than the percent of isobutane alkylated to 2-methylpentane, the data showed that this source of error was trivial. The effects of HCl on the alkylation reactions are pronounced. The C_6 product distribution appears to asymptotically approach a limiting value at high $[HCl]/[C_2H_4]_0$ which is consistent with an equilibrium between t-butyl and isobutyl radicals. The relative yields also represent mutual equilibrium among the free radicals. In that case the yield of each product relative to 2,2-dimethylbutane should be K/sub RH/ + tBu reversible → R. + iC_4H_{10} (/sup K/R. + C_2H_4/sup k/tBu + $C_2H_4$0). Although the available thermodynamic data do not have sufficient precision to permit accurate calculation of relative rate constants from data such calculations were carried out and the results were sufficiently self consistent to warrant reporting them in qualitative terms. Of the four primary free radicals studied, the neopentyl radical had the lowest rate of addition to ethylene. In general rate of radical addition to ethylene and radical thermodynamic stability were inversely correlated, the more stable radicals being less reactive. Under conditions where radicals tend toward mutual equilibrium, the thermodynamic factor is dominant, the stable radicals producing most of the product despite their lack of reactivity.

COMBUSTION

REFER ALSO TO CITATION(S) 5055, 5399, 6446

STORAGE

5244 **Development of porosity-gas saturation graphs for underground storage.** Harry, J. (Institut Francais due Petrole, Rueil-Malmaison, France); Blondin, E. pp 29p, Paper 27 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

The underground gas storage facilities of Beynes, Gournay, and Chemery were developed by Gaz de France in sand-sandstone carbonate reservoirs saturated with fresh water. The nature of the different types of gas stored, the lithology of each reservoir level, and the pressure and temperature conditions prevalent in each storage facility are known very precisely. The theoretical equations applicable to in-situ logging measurements are also known. It is then possible to develop a series of density/neutron graphs giving the total porosity and gas saturation for each of these storage facilities and for each reservoir level. These graphs have the advantage of: being relatively precise, even in the case of high gas saturations, and of having specific utility for each storage facility.

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 4941, 6083, 6084

5245 (FE—2343-6(Vol.5)) **Review and analysis of oil shale technologies. Volume 5. Appendixes and bibliography.** Jee, C.K.; White, J.D.; Bhatia, S.K.; Nicholson, D. (Booz-Allen Applied Research, Inc., Bethesda, MD (USA)). Aug 1977. Contract EX-76-C-01-2343. 95p. Dep. NTIS, PC A05/MF A01.

Seven appendices are included on: oil shale technology activities, ERDA oil shale program, method of assaying oil shale by a modified Fischer retort, environmental standards and regulations, supplemental information on various true in-situ processing steps, evaluation of in-situ oil shale experments by hot-film flow logging, and discounted cash flow rate of return method. The bibliography contains 133 references. (DLC)

5246 **Oil sands put Canada on firmer ground.** Rao, S.R. (Univ. of Lethbridge, Alberta). *New Sci.;* **79**: No. 1116, 462-464(17 Aug 1978).

Tar sands in Alberta are estimated to contain a potential 900 billion bbl of oil as bitumen. Present production runs to only 60,000 bbl/day of synthetic crude, but in-situ bitumen extraction methods could bring over 100 billion bbl within reach. This article discusses the nature of the tar sands, methods for processing them, and some of the problems involved. (DLC)

RESERVES AND EXPLORATION

5247 (USGS-OFR—77-637) **Oil-shale resource investigations of the U.S. Geological Survey.** Donnell, J.R. (Geological Survey, Menlo Park, CA (USA)). 1977. 46p. Geological Survey, Washington, DC.

The Geological Survey's oil-shale investigations are described in the context of the underlying socio-economic problem of expanding the domestic production of oil and gas while maintaining acceptable environmental standards. The oil-shale program includes geologic mapping, stratigraphic and mineralogical studies, etc. The relation of the program to other groups is described. Program

accomplishments in FY 1976 and the transition quarter are summarized. (DLC)

SITE GEOLOGY

REFER ALSO TO CITATION(S) 5266

DRILLING, FRACTURING, AND MINING

5248 (FE—2346-18) **Antrim oil shale: brine removal.** Evans, D.W. (Dow Chemical Co., Midland, MI (USA). Hydrocarbons and Energy Research Dept.). Aug 1977. Contract EX-76-C-01-2346. 35p. Dep. NTIS, PC A03/MF A01.

Over 63,000 gallons of brine were removed from a ten well system on the front forty acres of Dow's Sanilac County Oil Shale Field Site using airlift and Reda pumps from December 17, 1976, to June 30, 1977. Brine continues to enter the system at 4,000 to 6,000 gallons/month, for the most part in a four well zone highly fractured by explosives. The system will be periodically airlifted or pumped from July until the conclusion of a combustion experiment scheduled from August 1977 to February 1978.

5249 (SAND—78-1003) **Explosive emplacement, arming, and firing for oil shale fracturing experiments at LERC site 6A, Rock Springs, Wyoming.** McEwen, L.W. (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 16p. Dep. NTIS, PC A02/MF A01.

Arming and firing activities conducted by Sandia Laboratories in connection with oil shale fracturing experiments at Rock Springs, Wyoming are described. A special slurry explosive (DBA-1) was emplaced in three bore holes at different locations at LERC Site 6A. The three charges were detonated; the results were as expected.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 6448

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 4990, 5252

5250 (SAND—78-1196) **Oil shale programs. Ninth quarterly report, January 1978—March 1978.** Boade, R.R. (ed.) . (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 48p. Dep. NTIS, PC A03/MF A01.

Three separate programs are being conducted: diagnostic and rock mechanics support for the LERC In Situ Oil Shale Program, advanced instrumentation and field projects for in situ oil shale processing, and in situ oil shale bed preparation study. The effort is directed primarily at in situ processing concepts (both true and modified). Field activities were centered primarily around the Rock Springs Site 12 hydraulic/explosive fracturing experiment, continuing with the assessment of the explosive fracturing phase of the experiment and initiating efforts for the retort phase. Evaluation of four slurry explosives for hydrofracture use was completed. Magnetic pressure-loading experiments were performed to examine the fracture strength in oil shale in the intermediate strain rate regime. Analytical and calculational efforts are also reported. (DLC)

5251 **Field experiment of reverse combustion oil recovery from a Utah tar sand.** Land, C.S.; Cuppe, C.Q.; Marchant, L.C.; Carlson, F.M. (Energy Research and Development Administration, Laramie, WY). *Interstate Oil Compact Comm. Com. Bull.;* **18**: No. 2, 53-60(Dec 1976).

A field experiment to recover oil from tar sand by reverse combustion was conducted at Northwest Asphalt Ridge in a 10-foot interval of the Rim Rock sandstone member of the Mesa Verde Formation at a 300-ft depth. Ignition was accomplished November 25, 1975, and the reverse combustion front was propagated successfully through the formation. Results of the field experiment differed significantly from laboratory tests; this is attributed primarily to the extreme heterogeneity of the tar sand formation. Observed temperatures in the burned area were lower than expected, but a large portion of the tar sand within the pattern boundaries was heated to the extent that the bitumen became mobile enough to be produced. After $3\frac{1}{2}$ weeks of operation, the project was terminated because of the inability of the surface production equipment to accommodate the heavy hydrocarbons being produced. Although the formation of the cracked products of reverse combustion was less than expected, this recovery process may be used successfully to heat the tar sand reservoir to a temperature high enough that the bitumen becomes mobile enough to be produced. 6 figs, 3 tables.

SURFACE METHODS

REFER ALSO TO CITATION(S) 4966

5252 (FE—2343-6(Vol.4)) **Review and analysis of oil shale technologies. Volume IV. Aboveground or surface technology.** Jee, C.K.; White, J.D.; Bhatia, S.K.; Nicholson, D. (Booz-Allen Applied Research, Inc., Bethesda, MD (USA)). Aug 1977. Contract EX-76-C-01-2343. 173p. Dep. NTIS, PC A08/MF A01.

A technical description and evaluation of retorting methods and scale-up scenarios of four representative methods are presented. The methods described and evaluated include the processes developed by the Bureau of Mines (BOM), the Union Oil Company "B," Petrosix, Paraho, TOSCO II, and the Superior Oil Company. For a future economic analysis, scale-up (ranging from 55,000- to 58,000-bbl/day production rate) scenarios are presented for BOM's Gas Combustion retort (GCR), Union "B," Paraho, and TOSCO II retorting processes. In general, the six aboveground processes selected are in an advanced stage of development as compared with in situ processes and several of them are ready for commercial-scale demonstration. There are, however, a few areas that still need further research and development before demonstration can be undertaken. Specific areas of research cannot be defined at this time because process information needed to identify these areas is mostly proprietary. The technical evaluation reveals that the aboveground retorting processes are viable with high scale oil recovery yields. The processes, however, have been tested only at the pilot or semiworks scale and need to be demonstrated on full-scale modules. The scale-up scenarios of the representative processes reveal that the logistics of the mining-to-processing operation will be a major problem at high production rates. For example, a nominal crude shale oil production rate of about 50,000 bbl/day will require mining at a rate exceeding present large-scale mining rates. The TOSCO II retorting process is the most energy intensive among Paraho, Union "B," and BOM's GCR because of its complexity, which annuls the benefit of less mining. The TOSCO II process, however, is still an attractive process, providing the technique is used with another technique to enhance resource utilization.

5253 (UCID—17910) **Oil shale project small retort run summary: Run S-12.** Ackerman, F.J.; Sandholtz, W.A.; Raley, J.H.; Biermann, A.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1978. Contract W-7405-ENG-48. 59p. Dep. NTIS, MF A01.

Portions of document are illegible.

The authors conclude that finely divided shale, broad particle size range, and bed packing characteristics are important factors in retort performance. Future experiments must explore the roles of these factors as they may relate to field operations. The roughness of axial temperature profiles coupled with some localized partial melting observed during inspection of the burned shale bed demonstrates that flow nonuniformities are associated with fine material. Yield loss owing to oil burning could have occurred due to diversion of gas flow by pockets of fines. Oil holdup and subsequent degradation in the fines may have been a factor contributing to the yield loss.

5254 (UCRL—52089(Pt.2)) **Kinetics of decomposition of Colorado oil shale. II. Carbonate minerals.** Campbell, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Mar 1978. Contract W-7405-ENG-48. 59p. Dep. NTIS, PC A04/MF A01.

The kinetics of decomposition of nahcolite, dawsonite, dolomite, and calcite in oil shale have been investigated using heating rates expected during typical combustion retorting. Furthermore, the rates of decomposition of calcite and dolomite in shale have been studied over a range of heating conditions from 2 to 20°C/min and CO_2 partial pressures of 0 to 1.0 atm. These results lead to the conclusion that, under typical combustion retorting conditions, most of the calcite reacts with SiO_2, rather than decomposing to CaO. Activation energies and preexponential factors characterizing the rate constants for the above reactions are also given; these "engineering" rate data are expressed in a form amenable for use in mathematical models of the retorting process. Also presented are x-ray data on the final product mineral phases in fully burned oil shale. These are found to be mainly members of the akermanite-gehlenite series and diopside. These products are formed from reactions in the solid state of the carbonates and/or their oxides with other minerals in the shale. A summary of enthalpy data for these reactions is given. Finally, the practical implications and limitations of these results for computational and experimental studies of large-scale shale combustion retorting processes are discussed. Included in this discussion are recent results showing the effects of steam on the mineral reactions in shale.

5255 **Apparatus and method for recovery of bituminous products from tar sands.** Porritt, B.T.; Johanson, L.A.; Noall, K.L. (to New Energy Sources Co.). US Patent 4,096,057. 20 Jun 1978. Filed date 10 May 1976. 10p.

An apparatus and method are disclosed for (1) reducing agglomerated masses of tar sand and (2) recovering as a bituminous product the bituminous matrix material therefrom. The apparatus includes a vessel which is divided into an attrition zone enclosed by a screen member, a sand separation zone and a product recovery zone. The vessel accommodates liquid which is, advantageously, a solvent into which the agglomerated masses of tar sands are introduced. The liquid is impelled vigorously upwardly into the attrition zone to create a high shear environment by which the tar sand masses are reduced by attrition into sand particles coated with the bituminous matrix material of the tar sand. The separated grains of sand are also stripped of the bituminous product by the high shear environment. The cleansed sand passes through the screen member surrounding the attrition zone into the sand separation zone. The liquid and the bituminous product removed from the sand passes to the product recovery zone.

5256 Method and apparatus for retorting oil shale. Brown, H. (to Mineral Concentrates and Chemical Co., Inc.). US Patent 4,094,769. 13 Jun 1978. Filed date 13 Jun 1977. 10p.

In a method and apparatus for recovering oil products from oil shale and like materials, controlled amounts of raw oil shale are delivered into an upper inlet of a downwardly sloping retort chamber that is constructed as readily portable. The raw oil shale is first moved in a direction countercurrent to gravity flow and crushed in the retort chamber by means of a rotating member that also serves to retain the oil shale in the retort chamber until a satisfactory recovery is completed. The crushed oil shale is confined to a relatively thin, downwardly moving layer in contact with a heated, inner, annular wall surface and moves by gravity flow between the inlet and a lower outlet to produce oil product vapors that rise to an upper portion of the retort chamber. The moving layer of the oil shale becomes spent as it passes through the retort chamber and finally is selectively discharged through the lower outlet. The oil product vapors are removed from the retort chamber into a condensing tube in which the vapors are condensed to a liquid form. The oil products are removed from the condenser by weight or are further refined in an adjacent refinery.

5257 Thermogravimetric studies on pyrolysis of pitch derived from hydrocracked Athabasca bitumen. Sekhar, M.V.C.; Ternan, M. (Dept. of Energy, Mines and Resources, Ottawa). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 208-217(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The pyrolysis of Athabasca bitumen pitch was investigated to find a better utilization made for this pitch in bitumen gasification processes. Explanations of a compensation effect in the pyrolysis reaction similar to that found in the decomposition of hydrogen peroxide are given. It is suggested that the amount and nature of coal ash or differences in coal hydrocarbon composition (coal macerals) may have some effect on the compensation effect in coal char. (JRD)

5258 Chemical and physical properties of shale oil from microwave heating. Damrauer, R.; Wall, E.T.; Lutz, W.; Bies, R.; Cranney, M. (Univ. of Colorado, Denver). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 260-261(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Oil produced by microwave heating is compared with oil obtained by other processes. Preliminary experiments have indicated that oil produced by microwave treatment of oil shale has characteristics suitable for further study. The pouring characteristics are good while other properties are either as good or nearly as good as those of oils from other processes. Attempts will be made in the future to better characterize the oil as to its chemical constituency. In addition experiments will be designed to better understand the interaction of microwave energy with oil shale and to assess the potential for a commercial microwave process.

REFINING

REFER ALSO TO CITATION(S) 6819

5259 Separation of nitrogenous and associated polar materials from bitumen and heavy oils. Sawatzky, H.; Ahmed, S.M.; George, A.E.; Smiley, G.T. (Dept. of Energy, Mines and Resources, Ottawa). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 11-20(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Results of an experiment to effect separation of the petroleum heavy fraction in Athabasca bitumen are given in which steps were taken to obtain more composition information and alleviate difficulties caused by polar materials in the sample. In this modified procedure for separating the nitrogenous compounds and associated polar materials, most of the neutral nitrogen compounds were obtained in the tail portions of the pentane and cyclohexane eluates. This precluded treatment using ferric chloride. Further concentration could be obtained by chromatography on a dual silica-alumina column. The polar materials retained on the ion-exchange resins after the pentane and cyclohexane elutions were removed quantitatively by minimum amounts of eluents. The exhaustive extractions are unnecessary and undesirable. The application of this modified procedure to the study of thermal hydrocracking products of the Athabasca bitumen indicated a substantial increase in the carbazoles and indoles content during hydrocracking.

5260 Chemical changes in nitrogenous materials during hydrocracking of Athabasca bitumen. Sawatzky, H.; Beshai, J.E.; George, A.E.; Smiley, G.T. (Dept. of Energy, Mines and Resources, Ottawa). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 21-29(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The nitrogenous materials in Athabasca bitumen which deactivate catalysts in refining processes were investigated. It was found that the nitrogen content increases in the liquid products of Athabasca bitumen due to non-catalytic thermal hydrocracking. Some amide compounds seem to be generated, but they diminish with severe treatment. Pyrrolic compounds increase, but the 2-quinolones that are present in the bitumen degrade to traces in the highly-cracked product.

5261 Sulfur-type changes during the hydrocracking of Athabasca bitumen. I. Naphtha fraction up to 200°C. George, A.E.; Pruden, B.B.; Sawatzky, H. (Dept. of Energy, Mines and Resources, Ottawa). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 30-35(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The effects of hydrocracking on the sulfur content of Athabasca bitumen were investigated. It was found that although the percentage sulfur content decreases in all the liquid fractions and asphaltenes of the bitumen, when the severity of hydrocracking is increased, the amount of sulfur present in the naphtha fraction increases steadily because of the increase of this fraction in the product. The main sulfur compound-types in the naphtha product are residual sulfur, aliphatic sulfides, and aromatic sulfides, in descending order. These sulfur groups show the same trend as the total sulfur on increasing the severity of hydrocracking, except in the most severely-treated product where the aliphatic sulfides remain constant. The catalytic product has a higher mercaptan content and lower concentration of residual sulfur, aliphatic sulfides, and aromatic sulfides than the non-catalytically-cracked product at nearly the same pitch conversion. This suggests that the formation of mercaptans could be an intermediate step in the desulfurization process. A modification for the procedure of potentiometric titration of sulfides, in hydrocracked products that have a high olefinic content, is described.

5262 Reviews of some chemical aspects of the formation of coke during thermal hydrocracking of bitumen. Belinko, K.; Denis, J.M. Ottawa; CANMET (1976). 13p.

The presence of two structurally different cokes in the thermal hydrocracker is attributed to differences in coking properties of the asphaltenes and the heavy aromatic oils of the bitumen. The chemical structure of the asphaltenes and heavy oils is reviewed to relate their structure and the type of coke formed when they are carbonized.

PURIFICATION

5263 Catalytic hydroprocessing of shale oil to produce distillate fuels. Sullivan, R.F.; Stangeland, B.E. (Chevron Research Co., Richmond, CA). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 322-341(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Results are presented of a study to demonstrate the feasibility of converting whole shale oil to synthetic crude resembling a typical petroleum distillate. Paraho shale oil was used in the study. Results show that Paraho shale oil can readily be dewatered and deashed by heating and settling. It can then be hydrodenitrified to make a premium refinery feedstock resembling desulfurized petroleum distillates. The 650°F+ fraction of the hydrofined shale oil makes an excellent fluid catalytic cracking feedstock. It produces high yields of high octane gasoline and low coke make similar to those obtained on hydrofined petroleum gas oils. The heavy naphtha fraction of the hydrofined shale oil would make a better catalytic reformer feed than those from paraffinic crude oils. The diesel fuel, after hydrofining to reduce nitrogen, would also be of high quality.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 4992, 6365

5264 Correlation of fuel nitrogen conversion to NO/sub x/ during the combustion of shale oil blends in a utility boiler. Mansour, M.N.; Gerstein, M. (South Calif Edison Co, Rosemead). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **23**: No. 1, 151-154(12 Mar 1978).

This paper reports on combustion tests which have been conducted by Southern California Edison Company to evaluate No/ sub x/ emission characteristics of shale oil (0.7% sulfur and 2% nitrogen) when burned in a utility boiler. The tests were conducted in a 45 MW Combustion Engineering boiler equipped with six face mounted oil burners each rated at 85 million Btu/hr. To comply with Air Quality Management District fuel sulfur content requirements shale oil was blended with low sulfur oil so that the average sulfur content of the fuel blend did not exceed 0.5%. Nitrogen content of the low sulfur fuel ranged between 0.2-0.25%. The NO/ sub x/ emission was evaluated when burning shale oil blends using both conventional and off-stoichiometric modes of combustion. The emission levels were determined for a developmental low NO/sub x/ burner (LNB) and a conventional mechanical atomizing Peabody type burner. Results are presented and discussed in terms of mechanisms proposed for nitrogen conversion during shale oil combustion.

5265 Correlation of shale oil 1-alkene/n-alkane ratios with process yield. Coburn, T.T. (Boston Univ.); Bozak, R.E.; Clarkson, J.E.; Campbell, J.H. *Anal. Chem.;* **50**: No. 7, 958-962(Jun 1978).

When shale oil, obtained by pyrolyzing oil shale in an autogeneous or inert gas environment, is analyzed by gas chromatography, the ratio of the 1-alkene to the n-alkane of the same carbon number can be correlated linearly with the percent oil yield. No pretreatment of the crude oil to remove tar bases or other components of the mixture is necessary. The method provides an analytical technique that may be useful in evaluating in-situ retorting conditions.

5266 Shear strength of Athabasca oil sands. Dusseault, M.B.; Morgenstern, N.R. (Univ of Alberta, Edmonton). *Can. Geotech. J.;* **15**: No. 2, 216-238(May 1978).

Although the behavior of slopes in oil sands suggests that the shear strength is high, the source of strength of the oil sand has not been explained. Therefore detailed oil sand strength testing was undertaken on samples obtained in a special manner. Strength tests on dense Ottawa sand, oil sand tailings and densely recompacted oil sand were performed: standard behavior was observed throughout. A series of triaxial and shear-box tests on undistributed oil sands demonstrated a Mohr failure envelope that is highly curved, which displays no cohesion intercept and which is extremely steep for the initial portion of the envelope. Optical and scanning electron microscope investigations have revealed a dense interpenetrative structure and a considerable degree of grain surface rugosity. These factors give rise to a very high dilation rate before failure, and the dilation rate is suppressed as normal stress increases. The suppression of dilation results in shear of grains and grain asperities, giving rise to an apparent cohesion intercept at higher normal stresses. Refs.

5267 Comparison of thermal analysis between Devonian shale and Green River oil shale. Wen, C.S.; Yen, T.F. (Univ. of Southern California, Los Angeles). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 253-259(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Results are presented of a comparison between Green River oil shale and Devonian shale by the use of the differential scanning calorimetry (DSC) and the thermogravimetric analysis. The effect of demineralization of shales upon heats of reaction is also reported. Results show that Devonian raw shale contains 2 to 3% (by weight) of pyrite. Pyrite is strongly associated with kerogen matrices in Devonian shales. It is extremely difficult to separate it from the shale organic material. The DSC curves of Devonian shale kerogen, pyrite mineral, and pyrite reduced kerogen are compared diagrammatically. The major DSC peak of pyrite centered around 550 to 560°C had been eliminated in the pyrite reduced kerogen. The heat of pyrite decomposition from Devonian shale kerogen was estimated to be 67.6 cal/g. Though transition temperatures of decomposition for both kerogen concentrates are identical (at 500°C), Devonian shale kerogen is much older in geological age and has higher aromaticity than Green River shale kerogen. The higher activation energy obtained from Devonian shale kerogen (64.9 kcal/g-mole vs 50 kcal/g-mole) could be due to a major reflection of aromatic bond breaking rather than a rupture of saturated aliphatic bond. This provides some internal information on structural difference between the kerogens. The thermal properties of Devonian shale are quite different from those of Green River oil shale. The associated pyrite in kerogen concentrate may contribute greatly to the effect on thermal degradation of Devonian gas-bearing shale. For the first time the differential scanning calorimetry was applied to determining thermal properties of Devonian shale as well as Green River oil shale. Results have been compared with published data on Green River oil shale.

DIRECT USES AND BY-PRODUCTS

5268 (CONF-771203—, pp 879-881) **Residual shale oil as a boiler fuel.** Fu, T.T. (Naval Construction Battalion Center, Port Hueneme, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5269 Feedstocks from processing of shale oils. Rudershausen, C.G.; Thompson, J.B. (E. I. du Pont de Nemours and Co., Inc., Wilmington, DE). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 241-252(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Conventional analytical and petroleum processing techniques were used in evaluations of Paraho and several other syncrudes for use as chemical feedstocks. Analytical data on these synthetic crudes are given and a feedstock flowsheet is included. It is noted that although appreciable conversion of shale oil to chemicals seems possible, improved efficiency by specific process adaptations to shale oil may well be possible. Alternatively, expectations must be tempered while recognizing that petroleum will remain a better source, but only as long as it's comparatively available. (JRD)

MARKETING AND ECONOMICS

5270 (MIT-EL—77-003) **Recent proposals for government support for the commercialization of shale oil. A review and analysis.** (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). 20 May 1977. Contract EX-76-C-01-2295-006. 58p. Dep. NTIS, PC A04/MF A01.

This report applies the general principles of government-supported commercialization programs to a specific case, that of a proposed program for the commercial demonstration of shale oil production. The report begins with a brief discussion of a proposed commercial demonstration program, followed by a section that sketches the historical, technological, and economic background of shale oil. The commercial implications of this background are discussed. Based on this information, the report then outlines probable industry action in the shale oil field if no government action were taken. Rationales for the proposed program are discussed, both those explicitly offered by the government and others that could have been offered. The program is then evaluated for its effectiveness in dealing with the various problems involved in starting and maintaining a commercially viable shale oil industry. The findings of the analysis are summarized.

ENVIROMENTAL ASPECTS

5271 (CONF-771042—, pp 87-114) **Assessment of oil-shale development: a problem in statistical design.** Dietz, D.R. (Fish and Wildlife Service, Grand Junction, CO); Barker, L.K.; Hoffman, E.G.; Elderkin, R.L. Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

The purpose of the Federal prototype oil-shale leasing program is to initiate a carefully controlled, environmentally sensitive effort to determine the economical, technical, and environmental feasibility of developing the billions of barrels of oil locked in the kerogen-rich marlstone of the Green River Formation located in the northeastern part of Utah and northwestern part of Colorado. These goals depend on the complete and accurate assessment of related environmental impacts, and the design and evaluation of mitigating technology. A major problem is the development of a statistically sound monitoring program that will permit early prediction of significant impacts.

5272 (UCRL—52468) **Institutional constraints and the potential for oil shale development.** Ramsey, W.J.; Borg, I.Y.; Thornton, R.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 6 Jul 1978. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

This report assesses the potential oil shale industry in the U.S., projects the degree of its importance, and examines the institu-

tional constraints that inhibit its development. Oil shale industry constraints are divided into two categories—near-term and long-term. The principal near-term constraints are insurmountable environmental regulations and the concomitant unlikelihood of profits. It is believed the environmental questions can be dealt with satisfactorily and the costs of exploiting shale oil made acceptable. As for the long-term constraints, they are unavoidable. The most important one foreseen is availability of adequate amounts of water, both in terms of withdrawals from natural sources and in terms of storage capacity. Air pollution, water pollution, and population pressures are also matters of concern that must be reckoned with. While it is impossible to quantify the effects of long-term constraints precisely, it is estimated that a mature shale oil industry would produce 2.5 million bbl/day under the most likely set of circumstances. (In the unlikely event that near-term constraints remain in effect, there will be no shale oil industry.) Under the most optimistic circumstances, the industry might produce 6.5 million bbl/day. In order for that to happen, however, some very large water-policy decisions would have to be made and other constraints would have to be removed or sharply modified.

NUCLEAR FUELS

RESERVES

5273 (USGS-OFR—77-592) **Geology of the Midnite uranium mine area, Washington: maps, description, and interpretation.** Nash, J.T. (Geological Survey, Washington, DC (USA)). 1977. 42p. Geological Survey, Washington, DC.

Bedrock geology of about 12 km^2 near the Midnite mine has been presented at 1 : 12,000 to provide description of the setting of uranium deposits. Oldest rocks in the area are metapelitic and metacarbonate rocks of the Precambrian (Y) Togo Formation. The chief host for uranium deposits is graphitic and pyritic mica phyllite and muscovite schist. Ore also occurs in calc-silicate hornfels and marble at the western edge of a calcareous section about 1,150 m thick. Calcareous rocks of the Togo are probably older than the pelitic as they are interpreted to be near the axis of a broad anticline. The composition and structural position of the calcareous unit suggests correlation with less metamorphosed carbonate-bearing rocks of the Lower Wallace Formation, Belt Supergroup, about 200 km to the east. Basic sills intrusive into the Togo have been metamorphosed to amphibolite.

5274 (LA-tr—78-34) **Mineralogical and petrographical studies conducted at Strasbourg on the natural reactors of Oklo.** Lafaye, F.G.; Weber, F. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Sedimentologie et Geochimie de la Surface). 1978. Translation of IAEA-TC—119/8. (CONF-771222—15). 31p. Dep. NTIS, PC A03/MF A01.

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

The petrographic and mineralogical studies have revealed around the reaction areas aureoles characterized by the type of phyllitic minerals which they contain. Starting from the outside and working inward these are the following: illite 1 Md and ferriferous chlorite (normal sediment), illite 2 Md, magnesian chlorite and Kaolinite, illite 1 M and vermiculite chlorite. Dissolution forms of detrital quartz which disappear in the aureole at illite 2 M or in the aureole at magnesium chlorite, according to whether the encasing is more or less sandy. This zonal distribution would be due to the combined effect of neutron bombardment and hydrothermal alteration due to the starting of a thermal siphon by the nuclear reactions.

EXPLORATION

REFER ALSO TO CITATION(S) 4990, 5097, 5185, 5356

5275 (CONF-771042—, pp 33-37) **Method for detecting clusters of possible uranium deposits.** Conover, W.J. (Texas Tech Univ., Lubbock); Bement, T.R.; Iman, R.L. Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

When a two-dimensional map contains points that appear to be scattered somewhat at random, a question that often arises is whether groups of points that appear to cluster are merely exhibiting ordinary behavior, which one can expect with any random distribution of points, or whether the clusters are too pronounced to be attributable to chance alone. A method for detecting clusters along a straight line is applied to the two-dimensional map of ^{214}Bi anomalies observed as part of the National Uranium Resource Evaluation Program in the Lubbock, Texas, region. Some exact probabilities associated with this method are computed and compared with two approximate methods. The two methods for approximating probabilities work well in the cases examined and can be used when it is not feasible to obtain the exact probabilities.

5276 (GJBX—37(78)) **Construction of calibration pads facility, Walker Field, Grand Junction, Colorado.** Ward, D.L. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Aug 1978. Contract EY-76-C-13-1664. 61p. Dep. NTIS, PC A04/MF A01.

A gamma-ray spectrometer facility was completed at Walker Field Airport, Grand Junction, Colorado, in November 1976. This report describes spectrometers and their calibration, the construction of the spectrometer facility, the radioelement concentrations, procedures for using the facilites, and environmental considerations. (LK)

5277 (GJBX—43(78)) **Study to develop essential planning data for conterminous U.S. aerial radiometric surveys.** (Texas Instruments, Inc., Dallas (USA)). Mar 1978. Contract EY-76-C-13-1664. 27p. Dep. NTIS, PC A03/MF A01.

Data essential to planning aerial radiometric surveys for uranium are presented for each 1 : 250,000-scale NTMS quadrangle of the conterminous United States on microfiche and in digital form on magnetic tape. Planning parameters include: quadrangle priority based on geology and known uranium occurrences, anticipated relative counting rates based on general soil moisture content and lithology, terrain evaluation for aircraft selection, estimates of average viable flying hours per month based on climatology, and a selection of airports suitable for DC-3 aircraft operations.

5278 (GJBX—89(77)R) **Preliminary report on uranium and thorium content of intrusive rocks in northeastern Washington and northern Idaho.** Castor, S.B.; Berry, M.R.; Robins, J.W. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Nov 1977. Contract EY-76-C-13-1664. 44p. Dep. NTIS, PC A03/MF A01.

This study delineates favorable areas for uranium resources in northeastern Washington and northern Idaho by identifying granitic rocks with relatively large amounts of uranium and (or) thorium. Results are based on analysis of 344 rock samples. Uranium analyses obtained by gamma-ray spectrometric data correlate closely with fluorometric determinations. On the basis of cumulative frequency distribution curves, more than 8 ppM equivalent uranium and more than 20 ppM equivalent thorium are considered anomalous for granitic rocks in northeastern Washington and northern Idaho. Granitic rocks anomalously high in uranium and (or) thorium are concentrated in two northeast-trending belts. The most prominent, the Midnite-Hall Mountain belt, includes the Midnite and Sherwood uranium mines, and two lesser but productive areas farther north. This belt follows the contact between Precambrian and Paleozoic rocks, which is also the locus of the Kootenai arc fold belt. The second belt of anomalously radioactive granitic rocks is along the Republic graben, a prominent linear structure in an area with no recorded uranium production. Anomalously radioactive granitic rocks are generally massive quartz monzonite, alaskite, or pegmatite, which contain abundant quartz and potash feldspar. They are also characterized by pink potash feldspar, commonly as large phenocrysts, and by the presence of muscovite. Several uranium and thorium minerals have been identified in these rocks. The two belts of anomalously radioactive plutons are considered favorable for uranium resources. Deposits could occur in the intrusive rocks themselves or in favorable environments in adjacent rocks. 13 figs., 2 tables.

5279 (LA—7182-MS) **Uranium Hydrogeochemical and Stream Sediment Reconnaissance data release for the New Mexico portions of the Hobbs and Brownfield NTMS quadrangles, New Mexico/Texas.** Warren, R.G.; Nunes, H.P. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 65p. (GJBX—103(78)). Dep. NTIS, MF A01.

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U concentrations in waters approximate a lognormal distribution with a mean of 4.73 parts per billion (ppB) for the combined water samples from the western halves of both quadrangles. The highest U concentration found in a water sample is 139.7 ppb. About 93% of these samples were collected from 1008 wells. Of the remainder, 1 sample was collected from a spring and 75 samples were collected from combined surface water sources of artificial and natural ponds. The mean U content of the samples from surface water sources (7.63 ppB) is higher than that of the samples from wells (4.50 ppB). The water samples having the highest U content are from wells and ponds in the western, and especially the northwestern, portion of the Brownfield quadrangle. Most waters containing less than 20 ppB U were collected from areas in which the Dockum group underlies a thin veneer of surficial deposits, near the edge of the caprock, or from saline ponds. The U concentrations in sediments approximate a normal distribution with a mean of 2.18 ppM for the 914 sediment samples collected from the western halves

of both quadrangles. The highest U value found in a sediment sample is 19.3 ppM. Sediments were collected from 154 dry streams, 522 dry natural ponds, 166 dry artificial ponds, and a total of 72 wet natural ponds, wet artificial ponds, and springs. The mean U content for sediments derived from the wet sources (2.77 ppM) is noticeably higher than that from dry sources (2.11 ppM).The highest U contents within the report area generally are associated with sediments collected from locations in which the Dockum group underlies a thin cover of surficial deposits. A cluster of seven sediments containing more than 3.0 ppM U is centered at 33° 34'N, 103° 53'W, where a U occurrence is reported at the Hoffaeker test hole in the middle Dockum group.

5280 (LA—7237-MS) **Uranium hydrogeochemical and stream sediment reconnaissance of the Cheyenne NTMS Quadrangle, Wyoming.** Trexler, P.K. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 69p. (GJBX—106-78). Dep. NTIS, MF A01.

Portions of document are illegible.

Between June 1976 and October 1977, 1138 water and 600 sediment samples were systematically collected from 1498 locations in the Cheyenne NTMS quadrangle of southeast Wyoming. The samples were analyzed for total uranium at the Los Alamos Scientific Laboratory. The uranium concentration in waters ranged from 0.01 to 296.30 parts per billion (ppB), with a median of 3.19 ppB and a mean of 8.34 ppB. The uranium in sediments ranged from 0.8 to 83.0 parts per million (ppM) with a median of 3.4 ppM and a mean of 4.5 ppM. Arbitrary anomaly thresholds were selected to isolate those water and sediment samples containing uranium concentrations above those of 98% of the population sampled. Using this procedure, 23 water samples above 54.50 ppB and 12 sediment samples above 14.0 ppM were considered anomalous. Several areas appear favorable for further investigation for possible uranium mineralization. High uranium concentrations were detected in waters from the northeast corner of the Cheyenne quadrangle. High uranium concentrations were detected in sediments from locations in the southern and central Laramie Mountains and along the southeast and east-central edges of the study area.

5281 (LA—7463-PR) **Geostatistics project of the National Uranium Resource Evaluation Program. Progress report, April—June 1978.** Campbell, K.; Wecksung, G.W.; Whiteman, D.E.; Bement, T.R. (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract W-7405-ENG-36. 15p. Dep. NTIS, PC A02/MF A01.

Principal component analysis was applied to both the Lubbock and Plainview Quadrangles, and comparisons between the two regions were made. A procedure for locating outliers in multivariate data sets is being considered. The method is capable of locating outliers that can be missed by examining variables one at a time or by examining ratios. Work has begun to combine data from the Lubbock and Plainview Quadrangles in a pseudocolor display. An effort to combine LANDSAT and aerial radiometric data is under way.

5282 (SAND—78-1309C) **Corrections for prompt fission neutron uranium logging data.** Renken, J.H. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 6p. (CONF-781105—13). Dep. NTIS, PC A02/MF A01.

From ANS meeting; Washington, DC, USA (12 Nov 1978).

Portions of document are illegible.

Experience with actual PFN logging data shows the need to apply correction factors in order to extract ore-grade information from the data. The problem of defining suitable correction factors was studied in this paper. The epithermal/thermal ratio should be used as the indicator of measured uranium concentration, but the water content of the rock formation and the thickness of the water between the probe and the borehole wall need to be known in order to determine the correction factor. (DLC)

5283 (USGS-OFR—77-354) **Biogeochemical prospecting for uranium with conifers: results from the Midnite mine area, Washington.** Nash, J.T.; Ward, F.N. (Geological Survey, Washington, DC (USA)). 1977. 22p. Geological Survey, Washington, DC.

The ash of needles, cones, and duff from Ponderosa pine (Pinus ponderosa Laws) growing near uranium deposits of the Midnite mine, Stevens County, Wash., contain as much as 200 ppM uranium. Needle samples containing more than 10 ppM uranium define zones that correlate well with known uranium deposits or dumps. Dispersion is as much as 300 m but generally is less. Background is about 1 ppM. Tree roots are judged to be sampling ore, low-grade uranium halo, or ground water to a depth of about 15 m. Uptake of uranium by Douglas fir (Pseudotsuga menziesii (Mirb.) Franco) needles appears to be about the same as by Ponderosa pine needles. Cones and duff are generally enriched in uranium relative to needles. Needles, cones, and duff are recommended as easily collected, uncomplicated sample media for geochemical surveys. Samples can be analyzed by standard methods and total cost per sample kept to about $6.

5284 (USGS-OFR—77-766) **Factors controlling localization of uranium deposits in the Dakota Sandstone, Gallup and Ambrosia Lake mining districts, McKinley County, New Mexico.** Pierson, C.T.; Green, M.W. (Geological Survey, Washington, DC (USA)). 1977. 67p. Geological Survey, Washington, DC.

Geologic studies were made at all of the uranium mines and prospects in the Dakota Sandstone of Early and Late Cretaceous age in the Gallup mining district, McKinley County, New Mexico. Dakota mines in the adjacent Ambrosia Lake mining district were visited briefly for comparative purposes.

5285 **On-line analysis speeds uranium ore assays in central African empire.** Mannweiler, U.; Haftka, F.J. (Swiss Alum Ltd, Res and Dev). *World Min.:* **31**: No. 5, 56-57(May 1978).

Swiss Aluminium Ltd. has been carrying out feasibility study into the uranium deposits at Bakouma in the Central African Empire. Using X-ray fluorescence (XRF) spectrometry it has been possible to analyze a large number of ore samples with minimum labor and at low cost. 2 refs.

5286 **Uranium ore body analysis using the DFN technique.** West, J.; Hallenburg, J. pp T1-T5 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

The theory of the Delayed Fission Neutron (DFN) and Prompt Fission Neutron (PFN) uranium logging systems is reviewed. The use of the DFN in the field is described. The problems encountered in calibration, interpretation, and comparison with other techniques are covered. The results of the technique are accessed and illustrated and the costs are reviewed.

MINING

REFER ALSO TO CITATION(S) 5273, 5356

5287 (NUREG—0399(Draft)) **Draft environmental statement. Wyoming Mineral Corporation, Irigaray solution mining project (Johnson County, Wyoming).** (Nuclear Regulatory Commission, Washington, DC (USA)). Apr 1978. 173p. (DOCKET-408502—1). Nuclear Regulatory Commission, Washington, DC.

The Irigaray project consists of solution mining (in situ leaching) operations involving uranium ore deposits in Johnson County, Wyoming. Solution mining activities will include a processing facility with an annual production of 500,000 lb of U_3O_8 from up to 50 acres of well fields through the initial license authorization. The Irigaray project has an estimated lifetime of 10 to 20 years with known ore deposits and the current level of solution mining technology. Environmental impacts and adverse effects are summarized. The site is mostly used as grazing land for cattle and sheep. Initiation of the Irigaray project would result in the temporary removal from grazing and the disturbance of approximately 60 acres during operation. All disturbed surface areas will be reclaimed and returned to their original use. Approximately 1.2×10^6 m^3 (1000 acre-ft) of water will be withdrawn from the ore zone aquifer. This water will be conveyed to the onsite waste ponds for evaporation. An estimated 4.2×10^5 m^3 (340 acre-ft) of groundwater is expected to temporarily contain increased concentrations of radioactive and toxic elements during the operation of each 4-ha (10-acre) well field. Restoration should return this water to a condition that is consistent with its premining use (or potential use). There will be no discharge of liquid effluents from the Irigaray project. Atmospheric effluents will be within acceptable limits. The dose rates of radionuclides in the air at the nearest ranches from the plant site are tabulated. The Irigaray project proposes the production and utilization of 500,000 lb per year of uranium resources. The Irigaray project will not produce any significant socioeconomic impact on the local area because of the small number of employees that will be employed at the project.

5288 **Evaluation of five flowsheets for the recovery of uranium from wits leach pulps.** *S. Afr. Min. Eng. J.:* **89**: No. 4139, 50-51, 53, 55, 93(Apr 1978).

An incremental net present value is calculated for each flowsheet by discounting cash flows at 25 per cent per year over a projected life of 15 years. The highest net present value results from the circuit that employs belt filtration followed by continuous ion exchange, plus solvent extraction.

FEED PROCESSING

5289 (ORNL—5383, pp 80-82) **Miscellaneous programs.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

Covered are: ^{233}U processing, plans for drop testing of spent fuel cask, plans for converting old U solution to U_3O_8, nuclear safety assistance, and BNFP applicability study. (DLC)

5290 Uranium recovery from wet-process phosphoric acid. McCullough, J.F.; Phillips, J.F. Jr.; Tate, L.R. (to Tennessee Valley Authority). US Patent T970,007. 2 May 1978. Filed date 25 Mar 1977. 2p.

A method of recovering uranium from wet-process phosphoric acid is described in which the acid is treated with a mixture of an ammonium salt or ammonia, a metallic reducing agent such as iron, aluminum or zinc, and then a miscible solvent such as methanol. The precipitated solids, which are separated from the purified phosphoric acid, consist of a mixture of metal phosphates and uranium. This solid is dissolved in acid and the uranium recovered from the solution by liquid-liquid solvent extraction. The miscible solvent and some water are distilled away from the purified phosphoric acid. The distillate is rectified, the water discarded, and the miscible solvent recovered for recycle. When the miscible solvent is methanol, the optimum ranges of ammonia and methanol are 0.05 to 0.20 gram atom nitrogen per gram atom phosphorus and 1.93 to 3.15 pounds methanol per pound of orthophosphoric acid. The amount of reducing agent added should be sufficient to reduce all uranium to U(IV). Under these conditions, >99% the uranium is precipitated from the wet-process acid. About 90% of the phosphorus in the acid is recovered as purified phosphoric acid.

ENRICHMENT

REFER ALSO TO CITATION(S) 6467, 6468

5291 Separation nozzle: an aerodynamic device for large-scale enrichment of uranium-235. Becker, E.W.; Bley, P.; Ehrfeld, U.; Ehrfeld, W. (Kernforschungszentrum, Karlsruhe, Ger.). *Prog. Astronaut. Aeronaut.;* **51**: 3-16(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

This paper gives a review of the flow and diffusion phenomena in the separation nozzle. It is shown that admixing of a light auxiliary gas offers inherent advantages for the separation of heavy isotopic molecules in a centrifugal flow. The UF_6 is accelerated to a high speed ratio by the light gas already at a low expansion of the mixture--i.e., favorable conditions for centrifugal separation are obtained while aerodynamic losses are kept low. In addition, isotope separation is enhanced because of the different diffusion velocities of the isotopes relative to the light gas. Typical rarefaction phenomena are observed in the curved jet; the molecular velocity distribution is bimodal in large regions of the flow, and a velocity slip between the heavy UF_6 and the light auxiliary gas occurs.

5292 Isotope separation by the velocity-slip process. Raghuraman, P. (Boston Coll., Chestnut Hill, MA); Davidovits, P.; Anderson, J.B. *Prog. Astronaut. Aeronaut.;* **51**: 79-92(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

Two types of calculations are used to predict the velocity distributions and extent of separation for uranium-235 and -238 isotopes in the velocity-slip process. The three-component free jet flow is simulated as a source-flow expansion of $U^{235}F_6$ and $U^{238}F_6$ in He with entry conditions corresponding to equilibrium at M = 1 and to effusive flow. A successive-collision model, in which the increases in the average velocities of the two UF_6 species are determined in successive collisions with He, yields maximum separation factors α of 1.05 and 1.09 for mixtures containing 5 and 1 mole% UF_6, respectively. A direct simulation, by a Monte Carlo method similar to that developed by Bird, yields a maximum separation factor of about 1.05 for 5 mole% UF_6. Separate calculations in which cross-collisions between the two UF_6 species are eliminated show the effect of these collisions to be small under conditions for maximum separation. 8 figures.

GASEOUS DIFFUSION

5293 Problems of powder metallurgy in porous barrier fabrication. Szabo Miszenti, G. (Ist di Ric G. Donegani, Novara, Italy). *Energ. Nucl. (Milan);* **25**: No. 2, 85-91(Feb 1978). (In Italian).

Starting from general considerations on permeable porous systems, the basic features of porous barriers are defined, with particular reference to the uranium isotopic separation by UF$sub 6$ gas diffusion. Technological aspects and problems arising from the fabrication of such components are illustrated, in connection with the application of powder metallurgy techniques.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 6280, 6379, 6848

5294 (ORNL—5383, pp 3-6) **Fission energy.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

Research on the Sol-Gel Sphere-Pac method of fuel fabrication is reported. Methods for preparing fuel microspheres are reviewed. Experimental studies are being conducted on preparing UO_2 and UO_2—PuO_2 microspheres. (DLC)

5295 Mathematical analysis of the dependence of thermal conductivity on porosity. El-Fekey, S.A.; El-Mamoon Yehia, M.; El-Hakim, M.N.A. (At Energy Establ, Cairo, Egypt). *Powder Metall. Int.;* **10**: No. 2, 90-91(May 1978).

The effect of porosity on the thermal conductivity of thoria compacts was studied by applying a modified Maxwell formula derived by Murabayashi. Discrepancies were observed between the experimental results and Murabayashi relation. A more precise relation was suggested after using mathematical analysis. 9 refs.

5296 Preparation of dense uo$sub 2$ microspheres from colloidal ammonium polyuranate. Landspersky, H.; Urbanek, V. (Nucl Res Inst, Rez, Czech). *Powder Metall. Int.;* **10**: No. 2, 74-77(May 1978).

The process consists in a series of successive steps in which the solution of uranyl nitrate, urea, and uotropine is first dispergated into silicone oil heated to 90$degree$C, the formed gel is dried, reduced, and sintered. Examples of 3 types of dense UO$sub 2$ spheres are given with their mechanical and physical properties resulting from three types of xerogels obtained from one gel dried in three different ways. 6 refs.

5297 Correlations between sintering and agglomeration phenomena of UO_2 powders. Berti, R.; Frigeri, C.; Gondi, P.; Patuelli, C. (CNR, Univ di Bologna, Italy). *Energ. Nucl. (Milan);* **25**: No. 3, 143-151(Mar 1978).

This article describes a characterization study performed on two batches of UO_2 powder specimens by means of electron microscopy, X-ray diffraction, BET analysis, and sedimentometry under different wettability conditions. The observations concerned elementary particles, aggregates and agglomerates. The final properties after sintering seem to be referable to the agglomerate characteristics, i.e. to the macropores present into the agglomerates, while the micropores present among the elementary particles within the aggregates disappear during the initial sintering stages. 23 refs.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 5310, 5312, 5323, 6412

5298 (DPSPU—78-30-3) **SRP thorium processing experience.** Orth, D.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jun 1978. Contract EY-76-C-09-0001. 16p. (CONF-780622—72). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

In the five separate thorium processing campaigns conducted at SRP, thorium was processed in equipment and facilities which had been converted in 1959 to recover highly enriched uranium. Two different flowsheets were used and a total of approximately 240 tons of thorium and 580 kg of uranium was processed. In the first two campaigns (initial campaigns), uranium was recovered with a dilute 3.5% TBP flowsheet and the thorium was sent to waste. In these two initial campaigns, the irradiation conditions for the thorium metal resulted in concentrations of 40 to 50 ppM and 200 ppM ^{232}U in different batches of the product uranium. In the first of the last three campaigns (Thorex campaigns), thorium metal and thorium oxide were processed. Thorium oxide was processed in the remaining two Thorex campaigns. The three Thorex campaigns used 30% TBP to recover both uranium and thorium. Irradiation conditions were set to produce a concentration of 4 to 7 ppM ^{232}U. Dissolving rates for thorium metal exceeded 4 tons/day and with thorium sent to waste, solvent extraction rates increased and posed no limits. Dissolving and Thorex solvent extraction rates were approximately 1 ton/day when thorium oxide feed was used. Studies to increase the dissolving rates indicated that a small amount of MgO (1%) in the thorium oxide would be beneficial. Seven tons of thorium oxide with 1% MgO did give some promise of increased dissolving rates. Satisfactory flowsheets were developed, losses were satisfactory, and decontamination from fission products and protactinium were adequate. About the only unexpected event during the campaigns was the appearance of thorium dibutyl phosphate precipitates that appeared in the second thorium cycle during the first thorex campaigns

and interfered with operation. The system slowly returned to normal when the temperature was reduced.

5299 (GA-A—14930) **Particle classifier for HTGR fuel reprocessing. Engineering-scale unit interim development report.** Strand, J.B. (General Atomic Co., San Diego, CA (USA)). Jul 1978. Contract EY-76-C-03-0167-053. 74p. Dep. NTIS, PC A04/MF A01.

An engineering-scale air classification system for the separation of fissile and fertile fuel particles in the "cold" pilot plant of an HTGR Fuel Reprocessing Facility has been designed and tested. This report describes the tests conducted thus far and their results.

5300 (GA-A—15030) **Solvent extraction in HTGR reprocessing. Interim development report II.** Wilbourn, R.G. (General Atomic Co., San Diego, CA (USA)). Jul 1978. Contract EY-76-C-03-0167-053. 87p. Dep. NTIS, PC A05/MF A01.

This report contains the findings of a continuing program for the testing and evaluation of both Acid-Thorex and Purex flowsheets in HTGR fuel reprocessing. The tests were conducted to extend earlier studies on the effects of solvent degradation, feed solids impact, and decontamination performance using tracer ^{95}Zr. Experiments to date indicate that acceptable operation is attainable in the reprocessing of HTGR fuels through the use of tributyl phosphate (TBP) extractant and pulsed solvent extraction columns. A centrifugal contactor is acceptable for the extraction step of the Purex flowsheet.

5301 (ICP—1166) **Rover process verification studies: transport of dry solids.** Meyer, H.S. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). Sep 1978. Contract EY-76-C-07-1540. 42p. Dep. NTIS, PC A03/MF A01.

This report describes process verification studies on the performance of the dry solids transfer systems used in the reprocessing of Rover fuels. The effectiveness of the installed plant equipment was tested using full-scale mockups in the pilot plant. Gravitational and pneumatic transfers of simulated primary burner ash, simulated secondary burner ash, and alumina bed material were investigated. The transfer characteristics of the ejector systems were determined. The flow of solids between vessels and the transfer rates of solids by various air ejectors were tested.

5302 (ORNL—5383, pp 47-48) **Interphase transfer kinetics.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

Forward and reverse extraction rates of U and Th were determined as a function of TBP concentration. (DLC)

5303 (ORNL—5423) **High-temperature gas-cooled reactor fuel recycle development. Annual progress report for period ending September 30, 1977.** Lotts, A.L.; Kasten, P.R. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 254p. Dep. NTIS, PC A12/MF A01.

The status of the following tasks is reported: program management, studies and analysis, fuel processing, refabrication development, in-plant waste treatment, research general support, and major facilities including HTGR recycle reference facility, hot engineering test facility and cold prototype test facility-refabrication. (JRD)

5304 (ORNL/TM—6370) **Comparative studies of head-end processing using irradiated, mechanically blended and coprecipitated (U,Pu)O_2 reactor fuels.** Goode, J.H.; Stacy, R.G. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 45p. AT.

A series of experiments was performed with highly irradiated (U,Pu)O_2 to determine the effects of voloxidation on the release of fission products and on the subsequent dissolution characteristics. It was found that voloxidation was more effective at 600 than at 650°C for releasing the gaseous fission products ^{3}H, ^{14}C, and ^{85}Kr from the experimental fuels. The lower-temperature treatment released about 95% of the tritium, 97 to 98% of the ^{14}C, and about 56% of the ^{85}Kr. Less than 1% of the ^{106}Ru, ^{125}Sb, or ^{144}Ce were released, but up to 6% of the $^{134-137}$Cs was volatilized; most of the cesium deposited on the walls of the voloxidizer. Up to 80% of the ^{129}I was released, and most of it was carried into the off-gas system where it was sorbed onto activated charcoal. The voloxidizer at both temperatures generated a larger weight (1.5 to 2.2 times) of nitric acid insoluble residue than unvoloxidized (U,Pu)O_2. After voloxidation, the nitric acid insoluble residue also contained more plutonium than did the residue produced in the absence of voloxidation; another leach with 8 M HNO_3--0.05 M KF dissolved the plutonium. 23 tables, 8 figs.

5305 (TID—28778) **Improving process monitoring data for nuclear fuel reprocessing plants using state estimation and pattern recognition. Final report, May 15, 1977—September 30, 1978.** Gilchrist, R.W.; Bennett, J.E.; Barnett, W.J.; Bryan, J.K.; Komo, J.J. (Clemson Univ., SC (USA)). Sep 1978. Contract EY-77-S-09-1011. 100p. Dep. NTIS, PC A05/MF A01.

This report presents the results of a study of the technical feasibility of using statistical methods for improving process monitoring data in a nuclear fuel reprocessing plant. The data are improved in two senses. First, instrument observations contaminated by normally present instrument noise and process uncertainties are improved in accuracy. Secondly, the instrument observations are searched for errors that represent some abnormal instrument or system operation.

5306 (ANL-Trans—1141) **Contributions to the reprocessing of thorium—uranium nuclear fuels with the salt transport method.** Amecke, B. (Technische Univ. Braunschweig (Germany, F.R.)). Aug 1978. Translation of pp 24-27, 31-67, Doktors der Naturwissenschaften Dissertation, 1971. 41p. Dep. NTIS, PC A03/MF A01.

Excerpts from the dissertation are presented on cover gas composition, solubility of U in selected alloying systems, solubility of Th and U in Cu-Mg, solubility of U in Zn-Mg, solubility of U in Cd-Mg, solubility of U in Bi-Mg, distribution of Th between chloride and metal melts, distribution of Pa between salt and metal melts, and reduction of ThO_2. (JRD)

5307 Pyrochemical separation of plutonium from irradiated nuclear fuels, by thermal decomposition in molten nitrates. Brambilla, G.; Caporali, G. (to Agip Nucleare). US Patent 4,092,397. 30 May 1978. Priority date 17 May 1975, Italy. 6p.

A pyrochemical procedure for the recovery of Pu and U from irradiated fuel elements, especially those coming from fast nuclear reactors comprises disaggregating the severed fuel element by placing it in a bath of a molten alkali metal nitrate and/or alkaline earth nitrates and passing nitric vapors through the bath to affect dissolution of oxides and/or carbides. The insoluble fission products are removed by filtration, and the filtrate is heated to 300°C to decompose the plutonium compounds. The filtrate resulting from the removal of plutonium is then heated to 350°C to decompose the uranium compounds and precipitate the insoluble uranium.

5308 Nuclear speedup on the front burner. (McGraw-Hill Washington News Bur). *Power (N.Y.);* **122**: No. 5, 9-10(May 1978).

With the Administration showing renewed concern over its weak image in the nuclear power area, plans are being weighed for trimming by 50% the time required for siting, licensing, designing, and building nuclear plants. DOE plans for storage of fuel assemblies--but one can expect opposition from the states, which don't want nuclear storage within their territory.

5309 Comment on the interpretation and application of limiting critical concentrations of fissile nuclides in water. Clayton, E.D.; Durst, B.M. (Battelle-Pacific Northwest Labs., Richland, WA). *Nucl. Technol.;* **33**: No. 1, 110-111(Apr 1977).

Calculations of the infinite multiplication factor for aqueous homogeneous mixtures of mixed oxides of plutonium and natural uranium at low fissile concentrations (7 g Pu/l) disclose a maximum to occur in the value of k/sub infinity/ at a weight fraction, Pu/(Pu + U), of approximately 0.0035. With mixed oxide solutions containing 7 g Pu/l, the value of k/sub infinity/ is estimated to be nearly 1.04, whereas in the absence of the natural uranium, the maximum value of k/sub infinity/ at 7 g Pu/l in water is approximately 4% less or near unity. The occurrence of this peak in value of k/sub infinity/ is due to the ^{235}U content in the natural uranium. Thus, in the presence of natural uranium, it should be borne in mind that the limiting subcritical concentration of plutonium (given as 7.0 g Pu/l) in water must be reduced to values $<$7.0 g Pu/l to ensure subcriticality of the mixture.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 6413, 6414

5310 (AGNS—1040-1.4-20) **Studies and research concerning BNFP: LWR spent fuel storage.** Shallo, F.A. (Allied-General Nuclear Services, Barnwell, SC (USA)). Aug 1978. Contract ET-78-C-09-1040. 150p. Dep. NTIS, PC A07/MF A01.

This report describes potential spent fuel storage expansion programs using the Barnwell Nuclear Fuel Plant--Fuel Receiving and Storage Station (BNFP-FRSS) as a model. Three basic storage arrangements are evaluated with cost and schedule estimates being provided for each configuration. A general description of the existing facility is included with emphasis on the technical and equipment requirements which would be necessary to achieve increased spent fuel storage capacity at BNFP-FRSS.

5311 (DOE/EV—0004/2) **Shipments of nuclear fuel and waste: are they really safe.** (Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology). Aug 1978. 14p. Dep. NTIS, PC A02/MF A01.

This paper presents a summarized status report on the potential hazards of shipping nuclear materials. Principles of nuclear shipment safety, government regulations, shipment information, quality assurance, types of radioactive wastes, package integrity, packaging materials, number of shipments, accidents, and accident risk are considered. (LK)

5312 (NEDO—20825) **Safety evaluation report for Morris Operation Fuel Storage Expansion, Phase I.** (General Electric Co., San Jose, CA (USA). Fuel Recovery and Irradiation Products Dept.). Mar 1975. 57p. General Electric Co., San Jose, CA.

The GE fuel storage program consists of two phases. Phase I calls for an increase in the existing fuel storage capacity at Morris from about 100 metric tons of uranium (MTU) to 750 MTU. A tight schedule is required to meet the pressing needs for shipment and storage of irradiated fuel now stored in reactor basins. The Phase II plans include design and construction of a new storage basin or basins to meet capacity and timing needs that will be established in mid-1975. This safety evaluation report considers only Phase I of the fuel storage program.

5313 (NUREG/CR—0030) **PARC (Plutonium Accident Resistant Container) Program: research, design, and development.** Andersen, J.A.; Duffey, T.A.; Dupree, S.A.; Nilson, R.H. (Sandia Labs., Albuquerque, NM (USA)). May 1978. Contract EY-76-C-04-0789. 393p. (SAND—76-0587). Dep. NTIS, PC A17/MF A01.

The PARC (plutonium accident resistant container) project resulted in the design, development, and certification testing of a crashworthy air-transportable plutonium package (shipping container) for certification by the USNRC (Nuclear Regulatory Commission). This PAT-1 (plutonium air transportable) package survives a very severe sequential test program of impact, crush, puncture, slash, burn, and water immersion. There is also an individual hydrostatic pressure test. The package was engineered for a payload mass capacity of 3.15 kg of PuO_2 and a thermal capacity of 25 watts. The design rationale for very high energy absorption (impact, crush, puncture, and slash protection) with residual high-level fire protection, resulted in a reasonably small air-transportable package, advancing the packaging state-of-art. Optimization design iterations were utilized in the areas of impact energy absorption and stress and thermal analysis. Package test results are presented in relation to radioactive materials containment acceptance criteria, shielding and criticality standards.

5314 (PNL—3260-7) **Quarterly progress report, April 1—June 30, 1978 for study of plutonium oxide leak rates from shipping containers. Interim report.** Schwendiman, L.C.; Madia, W.J.; Mishima, J.; Sutter, S.L.; Bander, T.J.; Schmidt, E.W.; Yesso, J.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 29 Aug 1978. Contract EY-76-C-06-1830. 29p. Dep. NTIS, PC A03/MF A01.

Progress is reportd in the following tasks: Task C, Measure transmission of UO_2 powder through leaks (single orifice or capillary experiments and experiments with leakpaths above and below powder level were conducted); Task E, Investigate PuO_2 leaks through simulated and defected containers (room-temperature simulated crack experiments were conducted at helium flow rates of 11.4, 9.8, 11.6, and 13.2 cc/s). (9 figs, 5 tables) (DLC)

5315 (RHO-BWI-C—3) **Model of contaminant diffusion from a finite line source in a dense basalt stratum to an overlying permeable interbed.** Goldstein, P.; Hultgren, G.O.; Nelson, R.W. (BCS Richland, Inc., WA (USA). Scientific Consulting and Programming Dept.). Feb 1978. Contract EY-77-C-06-1030. 76p. Dep. NTIS, PC A05/MF A01.

The terminal storage of spent unreprocessed fuel is being proposed in deep repositories mined in dense rock layers. Little if any water may be found in some of these essentially dry basalt layers to mobilize and transport contaminants toward the biosphere. Under such conditions, solid diffusion is the remaining mechanism for migration from the mined repository to an overlying permeable interbed. This report provides a one-component diffusive model for calculating the minimum delay time for contaminants to first reach the overlying permeable interbed. The model considers diffusion from a horizontal line source of finite length located midway between the top and bottom of the dense essentially dry basalt stratum. The minimum delay time required for the contaminant to first reach the overlying interbed is a function of: (1) the thickness of the dense layer; (2) the coefficient of solid diffusion for the contaminant through the rock; and, (3) the concentration detection level used for defining first contaminant arrival. The smallest delay time due to diffusion calculated from the model is slightly greater than 1.8×10^7 years, when considering the worst combination of conditions, i.e., minimum stratum thickness, the largest diffusion coefficients reported in the scientific literature and a minimum detection level of 1% change in the arrival concentration. Under less severe situations, i.e., greater stratum thickness and smaller diffusion coefficients, but with the same 1% detection limit, a minimum delay time of 4.5×10^{13} years is obtained. 9 figs., 6 tables.

5316 (SAND—78-0225C) **Waste transportation systems.** Sutherland, S.H.; Freedman, J.M.; Allen, G.C. Jr.; Renken, J.H.; Dupree, S.A. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 6p. (CONF-780622—49). Dep. NTIS, MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Portions of document are illegible.

Shipping systems are being developed for three nuclear waste types: PWR and BWR spent fuel (SF), high-level waste (HLW), and clad waste (CW). Preliminary work on conceptual cask designs is discussed. Shielding of the cask is considered. Work shows that special attention must be given to the impact of recycle economies on shipping systems. (DLC)

5317 **Review of the Department of Transportation (DOT) regulations for transportation of radioactive materials.** Washington, DC; Dept. of Transportation (1977). 44p.

Purpose of this review is to summarize the basic requirements of the DOT regulations governing the packaging and shipment of radioactive materials and to provide guidance toward applying those regulations in actual practice. This review is a reference and guidance type document for training purposes. Shipper and carrier requirements are discussed, as are the more frequently noted discrepancies in shipments. IAEA regulations are also covered. (9 figures, 9 tables) (DLC)

MARKETING AND ECONOMICS

5318 **Supplying Western Europe with separation product and its effects on natural uranium requirement.** Lurf, G.; Luetkemeier, E.; Max, A. (Nukem, Hanau, Ger). *At. Strom;* **24**: No. 1, 13-15(Jan-Feb 1978). (In German).

The supply of Western Europe with separation product is characterized by a discrepancy between the actual separation product requirement of the reactors and the supplies of separation product fixed by contracts, due to the delays of nuclear power plant extension programs. The fulfillment of the enrichment contracts results then in requirements far exceeding the requirements ensured by previous contracts which, if cumulated to 1987, will roughly double and will rival the actual natural uranium requirement for supplying the reactors. 3 refs.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 4944, 6026

5319 (CONF-780844—1) **Impact on waste management from the beneficial utilization of nuclear wastes.** Blomeke, J.O. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From Public oversite hearings on radioactive waste management; Washington, DC, USA (10 Aug 1978).

The beneficial utilization of waste, regardless of the form selected, is a type of interim retrievable storage. The waste is not eliminated from the environment; nor are any waste management problems solved. An inventory of all constituents utilized must be maintained, and all materials must eventually be returned to a responsible authority for final disposal. Ultimately, any decision concerning the large-scale utilization of wastes or waste constituents should be based on a detailed risk-cost-benefit analysis that considers the risk of radiation exposure to man. This is in contrast to the economic value of the particular beneficial use, as well as any additional costs to fuel reprocessing and waste management. Such a balanced study has not been made.

5320 (HEDL-TME—78-48) **Division of waste management programs. Progress report, July—December 1977.** Lerch, R.E.; Allen, C.R. (comps.). (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1978. Contract EY-76-C-14-2170. 64p. Dep. NTIS, PC A04/MF A01.

An acid fractionator and acid recycle equipment were added to the Radioactive Acid Digestion Test Unit (RADTU). The first simulated waste was processed through RADTU in November. By the end of December RADTU had been operated up to its design capacity of 4 kg of waste/hour without major problems. The unit was operated for 23 hours and processed 62 kg of waste during initial shakedown testing. Borosilicate glass specimens, containing up to 33 wt percent acid digestion residue, were made after the sulfur was removed. The glass had a density of 2.6 g/cm^3 and produced a two-fold decrease in residue volume. During tests on the solubility of thorium oxide in the acid digestion system, thorium oxide was

converted to a form, presumably thorium sulfate, that was soluble in either dilute nitric acid or water. Thorium sulfate has approximately the same solubility in acid digestion as plutonium, about 0.1 g/l, and strontium from the boric acid-cement samples were found to be excessively high during 14-day leach tests. Leach rates of cesium and strontium from the sodium sulfate-cement samples were much lower. Leach rate tests were also performed on mercuric iodate immobilized in cement. 12 figs., 10 tables.

5321 (LA—7259-PR) **Experimental studies of the degradation of RAD-wastes for the Sandia Laboratories waste isolation pilot project (WIPP). Progress report, 1 January—31 March 1978.** Zerwekh, A.; Kosiewicz, S. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

Progress is reported in an experimental program to determine the effects of radiolytic, thermal, catalyzed pyrolytic, and chemical degradation mechanisms on various forms of existing or proposed transuranic wastes. Several radiolysis experiments were initiated to investigate gas yields generated by radiolytic attack of ^{239}Pu on typical hydrogenous waste matrices at 1 atm pressure and at temperatures of 20 and 70°C. Insufficient time has elapsed for these samples to produce meaningful data. A high-pressure vessel and liner have been fabricated and successfully safety tested. Required minor modifications to the vessel are being made. Anaerobic threshold decompositions of selected waste matrices were made with several potential catalysts—sodium chloride, powdered iron, iron oxide, and ferrous chloride. None of these produced significant lowering of the threshold decomposition temperature for any waste material tested. The lowest threshold decomposition temperature observed was 150°C.

5322 (NSC-PS-ARH—77001) **Risk analysis methodology and data: study of alternatives for long-term management of Hanford defense high-level radioactive waste.** (Nuclear Services Corp., Campbell, CA (USA)). Sep 1978. Contract EY-77-C-06-1001. 176p. Dep. NTIS, PC A09/MF A01.

This report provides information on the risk analysis performed in conjunction with the study of alternatives for the long-term management of the defense high-level radioactive waste at the Hanford Reservation, Richland, Washington. The risk analysis was done on a modular basis. The modules include: waste retrieval, waste preparation, waste immobilization, transportation, and storage and disposal. Based on the values obtained in this risk analysis, it is apparent that the overall risk either to an individual or to the population is extremely low.

5323 (ORNL—5383) **Chemical Technology Division annual progress report for period ending March 31, 1978.** Ferguson, D.E. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 116p. Dep. NTIS, PC A06/MF A01.

Separate abstracts were prepared for the various sections on fission energy, coal conversion and utilization, waste management, basic science and technology, biotechnology and environmental studies, special isotope production and separations, Nuclear Regulatory Commission programs, and miscellaneous programs.

5324 (ORNL—5383, pp 23-31) **Waste management.** Aug 1978. In Chemical Technology Division annual progress report for period ending March 31, 1978.

Work in the following fields is reported: partitioning and transmutation, removal and segregation of radionuclides and nitrates from liquid wastes, removal of organic contaminants and tritium from fuel reprocessing effluent streams, fixation of wastes in concretes, cement grouts for waste sludge disposal by hydrofracture, cements for plugging boreholes, updating ORIGEN, projection of wastes from fuel cycle, and assistance to OWI. (DLC)

5325 (PNL—2625) **Characterization on the high-level waste glasses. Annual report.** Ross, W.A.; Bradley, D.J.; Bunnell, L.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 70p. Dep. NTIS, PC A04/MF A01.

The waste compo itions PW-7c and PW-9 were defined and glass development was completed. Major variations in major oxide concentration would not grossly affect the leach rates of the glass. Impact and strength tests on nonradioactive glass showed that the waste glasses produced slightly less fine particulate than commercial glass. Waste glass had 60% of the strength of the soda-lime glass. A water-quench reduced thermal conductivity about 20%, and a 24-h hold at devitrification temperatures did not produce a significant change. Densities of waste glass at process temperature were 6.6 to 9.3% lower than at room temperature. The effects of glass composition on volatility were measured. Leach tests of highly devitrified samples of 72-68 have shown that leach rates of Cs, Sr and U are increased up to 10X and that Zn leach rates are reduced by nearly 200X. In glass 76-68, where devitrification is much slower, elemental differencesbetween as-formed and thermally-treated samples have not been significant. Average Cs leach rates from the 76-68 glass in an IAEA type long-term test have decreased to 3.3×10^{-8} g/cm²/day. High temperature (250 and 350°C) leach tests showed that glass is comparable to other ceramic materials. In salt brine the glass is rapidly depleted of Cs, Rb and Mo; in water the glass structure is rapidly rearranged to a crystalline structure, and Cs and Rb tend to remain bound in the solid. 76-68 glass (low ZnO) has slow devitrification kinetics compared to 72-68 glass (high ZnO). After equivalent radiation exposures of 300,000 years, the glass buttons still retain their original physical appearance. Stored energy is not a problem for HLW glasses. Density changes are small and do not affect the integrity of the samples. (DLC)

5326 (RHO-LD—78-3-C) **Process technology and process development. Quarterly report, April 1978 through June 1978.** (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Aug 1978. Contract EY-77-C-06-1030. 169p. Dep. NTIS, PC A08/MF A01.

This quarterly report is the ninth in a series intended to provide information on research and engineering activities being performed to improve the processing of irradiated reactor fuels, the production of plutonium, and the management of resultant chemical wastes.

5327 **West Germany's efforts to close the nuclear fuel cycle: strategies for radioactive waste management.** Krugmann, H. (Princeton Univ, Cent for Environ Stud, NJ). *Int. J. Energy Res.;* **2**: No. 2, 107-121(Apr-Jun 1978).

The radioactive wastes that would be generated in a closed nuclear fuel cycle are described. A brief discussion is given of the motives that underlie the current international disagreement regarding the desirability of, and the need for, closing the nuclear fuel cycle. West Germany's concept for closing the nuclear fuel cycle is outlined including institutional arrangements and responsibilities. A discussion of radioactive waste classification follows. Expected volumes and inventories of radioactive wastes are pointed out. Current practices, and research and development work in the treatment and disposal of radioactive wastes are outlined. A final section is devoted to the history, circumstances and implications of the current requirement for a 'solution' for the back end of the nuclear fuel cycle as a precondition for continued expansion of nuclear power in West Germany. 45 refs.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 5327, 6313

5328 (BNL-NUREG—50692) **Properties of radioactive wastes and waste containers. Quarterly progress report, January—March 1977.** Colombo, P.; Neilson, R.M. Jr. (Brookhaven National Lab., Upton, NY (USA)). Aug 1977. Contract EY-76-C-02-0016. 60p. Dep. NTIS, PC A04/MF A01.

The densities of the simulated wastes used in this program were determined and factors reported to allow conversion of formulation data for urea-formaldehyde (UF) waste forms from weight ratios to volume ratios of waste to UF. Simulated Solka-Floc wastes were solidified with urea-formaldehyde but areas of unsolidified Solka-Floc were found in the final waste forms. The difficulty in mixing dewatered Solka-Floc waste with UF is presumed to be responsible. Attempts to solidify alkaline regenerative wastes with urea-formaldehyde were not successful. Increasing the waste/UF volume ratio to 3.0 produced acceptable solids with boric acid and decontamination waste, but not with chemical regenerative wastes. The use of masonry cement (one part Portland cement to one part anhydrous lime by weight) for the solidification of boric acid concentrate waste was investigated. Free standing solids were formed at waste/cement weight ratios of 0.6 and 1.0 but not at 1.5 or 2.0. Masonry cement was found to be superior to Portland cement for the solidification of boric acid wastes. The weight loss with temperature of urea-formaldehyde waste forms containing various simulated wastes was measured over the range of 25 to 500°C. Weight losses due to the evaporation of water, decomposition of UF and decomposition of the wastes were observed. Static leaching experiments were conducted to determine the rate of release of cesium-137 and strontium-85 from urea-formaldehyde specimens and bead and powdered cation exchange resins. Results for the leaching of these materials in salt water, tap water, and distilled water are reported. Hydrostatic testing of modified DOT 17H open head 55 gallon drums was performed. These drums met the required DOT specifications and ultimately failed at an average pressure of 44 psig by separation of the drum head from the drum body at the gasket.

5329 (ICP—1164) **Ruthenium behavior during calcination.** Newby, B.J.; Rhodes, D.W. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). Sep 1978. Contract EY-76-C-07-1540. 37p. Dep. NTIS, PC A03/MF A01.

The volatility of ruthenium during fluidized-bed calcination of highly radioactive nuclear fuel reprocessing waste was deter-

mined in laboratory and pilot-plant studies using synthetic waste, and during production-scale calcination of actual radioactive waste. Factors affecting the volatility of ruthenium under various calcination conditions are described and a method is given for removing volatile ruthenium from calciner off-gas using a solid sorbent. Ruthenium in calciner off-gas is predominantly particulate when the calciner is heated by in-bed combustion of kerosene at 500°C, but significant quantities of volatile ruthenium are produced when the calciner is heated indirectly at 400°C. Silica gel was determined to be the best sorbent for removing volatile ruthenium from calciner off-gas.

5330 (MLM—2541) **TRU Waste Cyclone Drum Incinerator and Treatment System: April—June 1978.** Klingler, L.M.; Batchelder, D.H.; Lewis, E.L. (Mound Facility, Miamisburg, OH (USA)). 28 Jul 1978. Contract EY-76-C-04-0053. 16p. Dep. NTIS, PC A02/MF A01.

The cyclone incinerator was operated throughout the quarter utilizing the new lid assembly. Burning rates averaged 35.1 kg/h. Early indications are that equipment life expectancies may also have lengthened. Efforts continue on selection of a system to dry sludges generated in the off-gas treatment system. A quality control program was started this quarter. The ash/cement matrix studies were completed. The 65/35 mixture proved to be the best for dry-cure pellets, and the 80/20 mixture produced the best wet-cured pellets. Experimental incinerator ash was successfully sintered; the final carbon content was less than 0.1 wt%.

5331 (ORNL—5383, pp 32-39) **Separations sciences.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

1,1,1,2,2,3,3-heptafluoro-7,7-dimethyl-4,6-octanedione (HFDMOD) is being studied for extracting cations. Methods and agents for separating actinides from U ore processing streams and fuel reprocessing wastes are being studied. Zinc in HEPA filters was found to increase penetration by alpha-active materials. Distribution data are given for the extraction of acetic acid by amines, of alkali metals by HDEHP and crown ethers, of Eu by DEHDECMP, and of alkali and alkaline-earth metals by HFDMOD. Removal of tritium from lithium by sorption on yttrium was studied. (DLC)

5332 (ORNL—5438) **Nitrogen oxide absorption into water and dilute nitric acid in an engineering-scale sieve-plate column: description of a mathematical model and comparison with experimental data.** Counce, R.M. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 165p. AT.

The study reported here is concerned with the absorption of gaseous NO/sub x/ compounds into water and dilute HNO_3 in a three-stage sieve-plate column with plates designed for high gas-liquid interfacial area. The performance of the column was measured while several operating parameters were varied. A mechanistic model was developed and presented to explain the observed phenomena. The results of the study indicate the importance of three mechanisms in the absorption of gaseous NO/sub x/ compounds: (a) the absorption of NO_2*, which results in the production of liquid HNO_3 and HNO_2; (b) the dissociation of the liquid HNO_2 into HNO_3 and gaseous NO; and (c) the gas-phase oxidation of NO to NO_2. A useful model was developed to explain the absorption of NO/sub x/ compounds based on the above mechanisms. This model is presented and discussed.

5333 **Thermodynamically stable product for permanent storage and disposal of highly radioactive liquid wastes.** Guber, W.; Saidl, J.; Daruschy, P.; Hild, W. (to Gesellschaft fuer Kernforschung m.b.H.). US Patent 4,097,401. 27 Jun 1978. Priority date 30 Jul 1975, German, Federal Republic of (F.R. Germany). 8p.

Highly radioactive liquid wastes are permanently stored in a solidification matrix containing the components of a known borosilicate glass together with nucleation agents selected from the group consisting of oxides of Li, K, Mg, Mo and Cr, fluorides of those metals and of Al, and pure noble metals in the elemental form with particles with sizes smaller than 0.1 μm in diameter, and up to 35% by weight of waste fission and corrosion products or waste fission and corrosion products and gadolinium oxide. The product is produced by denitrating and calcining the radioactive waste solution, melting the calcined waste product together with a borosilicate frit containing nucleation agents at a temperature of between 1,050 and 1,200°C, and maintaining it in its melted state for 3 to 5 hours, subsequently cooling the resulting mixture until to a given temperature and maintaining it at this temperature for a given time period to permit nucleation to occur, then elevating the temperature of the mixture with a constant heating rate until to a given higher temperature, maintaining it at this higher temperature for about 24 hours, and finally cooling it with a constant cooling rate to ambient temperature.

5334 (ORNL-tr—4650) **Process for treating radioactive wastes.** Cuaz, D.; Thiery, D. 1975. Translation by S.D. Blalock Jr. of French patent No. 2,273,350. 3p. Dep. NTIS, PC A02/MF A01.

In this process, the radwastes in a dry powder state are incorporated in a polymerizable resin at room temperature, and the resin is then copolymerized with a monomer to obtain a solid block. Two examples are given of the application of this process to a radioactive sediment containing filtration and flocculation agents. (DLC)

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 5308, 5315, 5327, 5328, 5451, 5823, 5866

5335 (BNL-NUREG—50861) **Evaluation of isotope migration: land burial. Water chemistry at commercially operated low-level radioactive waste disposal sites. Progress report No. 7, October—December 1977.** Colombo, P.; Weiss, A.J.; Francis, A.J. (Brookhaven National Lab., Upton, NY (USA)). Jan 1978. Contract EY-76-C-02-0016. 34p. Dep. NTIS, PC A03/MF A01.

Trench water samples from the commercial low-level radioactive waste disposal sites at Maxey Flats, Kentucky, and West Valley, New York, were collected, and the bacterial populations were enumerated. The range of bacterial populations in six trench water samples were 400 to 24,000 aerobic and 90 to 15,000 anaerobic bacteria/ml. Most of the bacteria isolated from the anaerobic culture plates were facultative anaerobes, although a few strict anaerobes were also present. Mixed bacterial populations isolated from the trench waters were able to grow anaerobically utilizing the carbon and nitrogen sources present in the trench waters. Trench waters supplemented with mineral salts supported only a modest increase in growth of these bacteria. The results of this study indicate that bacteria are active in the trenches, and the radioactivity and organic compounds present in the trenches are not toxic to these bacteria.

5336 (CONF-771042—, pp 158-171) **Statistical methodology for use in risk assessment of radioactive waste disposal in geologic media.** Inman, R.L. (Sandia Labs., Albuquerque, NM). Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

The development of a statistics methodology for use in risk assessment of radioactive waste disposal in geologic media poses a unique and interesting challenge. The models involved in the assessment are sometimes quite long and involved. Some of the models contain many defined but unknown parameters, and in many cases little or no data are available for parameter estimation. Also, many variables are used, and only a few of them may be of value. Once the individual models are analyzed, it is necessary that the various models interface properly and that some meaning is attached to the output, which is a random function of the input and is dependent upon site selection. We hope to develop the statistical methodology for analyzing such a complex system.

5337 (CONF-780740—3) **Analysis of disposal of uranium mill tailings in a mined out open pit.** Staub, W.P.; Triegel, E.K. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 31p. Dep. NTIS, PC A03/MF A01.

From Management, stabilization, and environmental impact of uranium mill trailings; Albuquerque, NM, USA (24 Jul 1978).

Mined out open pits are presently under consideration as disposal sites for uranium mill tailings. In this method of tailings management, the escape of contaminated liquid into an adjacent aquifer is the principal environmental concern. The modified Bishop Method was used to analyze the structural stability of a clay liner along the highwall and fluid flow models were used to analyze the effect of tailings solutions on groundwater under several operating conditions. The slope stability of a clay liner was analyzed at three stages of operation: (1) near the beginning of construction, (2) when the pit is partially filled with tailings, and (3) at the end of construction. Both clay lined and unlined pits were considered in the fluid flow modeling. Finally, the seepage of tailings solutions through the clay liner was analyzed. Results of the slope stability analysis showed that it would be necessary to construct the clay liner as a modified form of engineered embankment. This embankment would be similar in construction to that of an earthfill dam. It could be constructed on a 1 : 1 slope provided the tailings slurry were managed properly. It would be necessary to maintain the freeboard height between the embankment and tailings at less than 4 m. A partially dewatered sand beach would have to be located adjacent to the embankment. Potential leakage and aquifer contamination was modeled for lined and unlined pits of various designs. Sulfate, and possibly U and Th, are the most likely contaminants. Results from the model showed the clay and soil cement lined pit to be most effective in containing the pollutants.

5338 (CONF-7710136—, pp 85-91) **Dissolution of Kansas evaporites: the radioactive waste disposal problem.** Smith, B.J. 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The radioactive waste repository at Lyons, Kansas, focused attention on the problem of evaporite dissolution. More study is needed in the determination of the mechanisms responsible for deterioration. Also, recent water-use policies have been questioned with the need pointed out for increased effectiveness in planning. Good water planning has to take into account the role of evaporite dissolution in water quality. 23 references.

5339 (LA—7379-MS) **Movement of fluids and plutonium from shafts at Los Alamos, New Mexico.** Purtymun, W.D.; Garde, R.; Peters, R. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-736. 8p. Dep. NTIS, PC A02/MF A01.

The movement of fluids and plutonium from wastes disposed in shafts drilled into rhyolite tuff were studied under normal and test conditions. During normal operations of a waste treatment plant at LASL, a $Fe(OH)_3$ (ferric hydroxide) sludge is mixed with cement to form a paste and disposed into the shafts. Under these conditions there was no indication of movement of fluids into the tuff; however, there was some movement of paste into open joints that intersected the shaft. As a special test, some $Fe(OH)_3$ sludge without cement was put into an experimental shaft. In this case, fluids moved a few meters from the shaft. The fluids carried trace amounts of plutonium from the shaft, but an inventory indicated more than 99 percent remained adsorbed or attached to the sludge in the shaft.

5340 (ORNL/EIS—133/V1) **Shallow land burial of low-level radioactive wastes. A selected, annotated bibliography.** Fore, C.S.; Vaughan, N.D.; Tappen, J. (comps.). (Oak Ridge National Lab., TN (USA)). Jun 1978. Contract W-7405-ENG-26. 259p. Dep. NTIS, PC A12/MF A01.

The data file was built to provide information support to DOE researchers in the field of low-level radioactive waste disposal and management. The scope of the data base emphasizes studies which deal with the "old" Manhattan sites, commercial disposal sites, and the specific parameters which affect the soil and geologic migration of radionuclides. Specialized data fields have been incorporated into the data base to improve the ease and accuracy of locating pertinent references. Specific radionuclides for which data are presented are listed in the "Measured Radionuclides" field, and specific parameters which affect the migration of these radionuclides are presented in the "Measured Parameters" field. The 504 references are rated indicating applicability to shallow land burial technology and whether interpretation is required. Indexes are provided for author, geographic location, title, measured parameters, measured radionuclides, keywords, subject categories, and publication description. (DLC)

5341 (PNL—1904) **Research and development plans for disposal of high-level and transuranic wastes.** Bartlett, J.W.; Platt, A.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1978. Contract EY-76-C-06-1830. 75p. Dep. NTIS, PC A04/MF A01.

This plan recommends a 20-year, 206 million (1975 $'s) R and D program on geologic structures in the contiguous U.S. and on the midplate Pacific seabed with the objective of developing an acceptable method for disposal of commercial high-level and transuranic wastes by 1997. No differentiation between high-level and transuranic waste disposal is made in the first 5 years of the program. A unique application of probability theory to R and D planning establishes, at a 95% confidence level, that the program objective will be met if at least fifteen generic options and five specific disposal sites are explored in detail and at least two pilot plants are constructed and operated. A parallel effort on analysis and evaluation maximizes information available for decisions on the acceptability of the disposal techniques. Based on considerations of technical feasibility, timing and technical risk, the other disposal concepts, e.g., ice sheets, partitioning, transmutation and space disposal cited in BNWL-1900 are not recommended for near future R and D.

5342 (Pub—246) **Instrumentation/measurement techniques and philosophies for nuclear waste repositories.** Hustrulid, W. (Colorado School of Mines, Golden (USA). Dept. of Mining). May 1978. Contract W-7405-ENG-48. 67p. (CONF-780730—2). Dep. NTIS, PC A04/MF A01.

From Geotechnical assessment and instrumentation needs symposium; Berkeley, CA, USA (16 Jul 1978).

This document is intended to provide background material for review by participants prior to the July workshop. A number of questions on soil and rock mechanics have been posed which should be answered during the workshop. They cover observation and instrumentation, definition of pertinent terms, time frame of measurements, measurement program elements, data analysis, possibilities/limitations for long-term measurements, and quality assurance in instrumentation/measurement programs. (DLC)

5343 (SAND—78-0715) **Borehole Plugging-Materials Development Program.** Gulick, C.W. Jr. (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

This report discusses the background and first year's results of the grouting materials development program for plugging boreholes associated with the Nuclear Waste Isolation Pilot Plant. The grouts are to be pumpable, impermeable, and durable for many thousands of years. The work was done at the Concrete Laboratory of the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. The workability, strength, porosity, bonding, expansion, and permeability data are summarized and discussed. The work is continuing at WES.

5344 (TREE—1286) **Initial drum retrieval. Final report.** McKinley, K.B.; McKinney, J.D. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1978. Contract EY-76-C-07-1570. 31p. Dep. NTIS, PC A03/MF A01.

The Initial Drum Retrieval (IDR) program was initiated in FY-1974 to retrieve drums buried between 1968 and 1970. Retrieval operations began in July 1974, and concluded in June 1978. During this period, a total of 20,262 drums with a TRU waste volume of 4391 m^3 and 1 m^3 of contaminated soil were retrieved. Of this total, 18,029 drums plus the contaminated soil were repackaged and stored on 20-year interim storage pads. One drum containing ^{60}Co and ^{137}Cs sources was disposed into Pit 15. Evaporated salts, contained in 2232 drums, were disposed in the Transuranic Disposal Area. The condition of the buried drums limited IDR retrieval operations to Pits 11 and 12. The retrieval operations in Pits 11 and 12 were conducted under an Air Support Weather Shield (ASWS) for weather protection. A Drott excavator was used for returning the drums. After retrieval techniques were optimized, an average of 750 drums per month were retrieved. The retrieval operations were completed without serious injury or spread of contamination into the environment. The cost to retrieve 20,262 drums was $1,614,820 or about $80 per drum. The average cost per drum to retrieve during the last 2 years of operation was about $60.

5345 (Y/OWI/SUB—78/22337) **Communication of technical information to lay audiences.** Bowes, J.E.; Stamm, K.R.; Jackson, K.M.; Moore, J. (Washington Univ., Seattle (USA). Communication Research Center). May 1978. Contract W-7405-ENG-26. 130p. Dep. NTIS, PC A07/MF A01.

One of the objectives of the National Waste Terminal Storage (NWTS) Program is to provide terminal storage facilities for commercial radioactive wastes in various geologic formations at multiple locations in the United States. The activities performed under the NWTS Program will affect regional, state, and local areas, and widespread public interest in this program is expected. Since a large part of the NWTS Program deals with technical information it was considered desirable to initiate a study dealing with possible methods of effectively transmitting this technical information to the general public. This study has the objective of preparing a state-of-the-art report on the communication of technical information to lay audiences. The particular task of communicating information about the NWTS Program to the public is discussed where appropriate. The results of this study will aid the NWTS Program in presenting to the public the quite diverse technical information generated within the program so that a widespread, thorough public understanding of the NWTS Program might be achieved. An annotated bibliography is included.

5346 (Y/OWI/TM—36/3) **Technical support for GEIS: radioactive waste isolation in geologic formations. Volume 3. Stratigraphies of salt, granite, shale, and basalt.** (Dames and Moore, White Plains, NY (USA)). Apr 1978. Contract W-7405-ENG-26. 68p. Dep. NTIS, PC A04/MF A01.

This study presents the methodology and basic literature used to develop generic stratigraphic sections for the various geologic repository host rocks under considerations: salt, granite, shale and basalt.

5347 (Y/OWI/TM—36/5) **Technical support for GEIS: radioactive waste isolation in geologic formations. Volume 5. Baseline rock properties-granite.** (Dames and Moore, White Plains, NY (USA)). Apr 1978. Contract W-7405-ENG-26. 166p. Dep. NTIS, PC A08/MF A01.

Portions of document are illegible.

This volume, Y/OWI/TM-36/5, Baseline Rock Properties--Granite, is one of a 23-volume series, "Technical Support for GEIS: Radioactive Waste Isolation in Geologic Formations, Y/OWI/TM-36" which supplements a "Contribution to Draft Generic Environmental Impact Statement on Commercial Waste Management: Radioactive Waste Isolation in Geologic Formations, Y/OWI/TM-44." The series provides a more complete technical basis for the preconceptual designs, resource requirements, and environmental source terms associated with isolating commercial LWR wastes in underground repositories in salt, granite, shale and basalt. Wastes are

considered from three fuel cycles: uranium and plutonium recycling, no recycling of spent fuel and uranium-only recycling. This report, on the rock properties of typical granites, includes an evaluation of the various test results reported in the literature. Firstly, a literature survey was made in order to obtain a feel for the range of rock properties encountered. Then, granites representative of different geologic ages and from different parts of the United States were selected and studied in further detail. Some of the special characteristics of granite, such as anisotropy, creep and weathering were also investigated. Lastly, intact properties for a typical granite were selected and rock mass properties were derived using appropriate correction factors.

5348 (Y/OWI/TM—36/6) **Technical support for GEIS: radioactive waste isolation in geologic formations. Volume 6. Baseline rock properties-shale.** (Dames and Moore, White Plains, NY (USA)). Apr 1978. Contract W-7405-ENG-26. 151p. Dep. NTIS, PC A08/MF A01.

This volume, Y/OWI/TM36/6 Baseline Rock Properties--Shale, is one of a 23-volume series, "Technical Support for GEIS: Radioactive Waste Isolation in Geologic Formations, Y/OWI/TM-36" which supplements a "Contribution to Draft Generic Environmental Impact Statement on Commercial Waste Management: Radioactive Waste Isolation in Geologic Formations, Y/OWI/TM-44." The series provides a more complete technical basis for the preconceptual designs, resource requirements, and environmental source terms associated with isolating commercial LWR wastes in underground repositories in salt, granite, shale and basalt. Wastes are considered from three fuel cycles: uranium and plutonium recycling, no recycling of spent fuel and uranium-only recycling. The report is a result of a literature survey of the rock properties of shales occurring in the United States. Firstly, data were collected from a wide variety of sources in order to obtain a feel for the range of properties encountered. Secondly, some typical shales were selected for detailed review and these are written up as separate chapters in this report. Owing to the wide variability in lithology and properties of shales occurring in the United States, it became necessary to focus the study on consolidated illite shales. Using the specific information already generated, a consistent set of intact properties for a typical, consolidated illite shale was obtained. Correction factors, largely based on geological considerations, were then applied to the intact data in order to yield typical rock mass properties for this type of shale. Lastly, excavation problems in shale formations were reviewed and three tunnel jobs were written up as case histories.

5349 (Y/OWI/TM—36/9) **Supplemental technical information in support of Y/OWI/TM—44. Volume 9. Drawings for repository preconceptual design studies: salt.** (Parsons, Brinckerhoff, Quade and Douglas, Inc., New York (USA)). Apr 1978. Contract W-7405-ENG-26. 450p. Dep. NTIS, PC A19/MF A01.

Portions of document are illegible.

Volume 9 contains drawings for a preconceptual design for a nuclear waste storage facility in salt. Drawings are included for three fuel cycles: fuel recycle, throwaway fuel cycle, and uranium recycle with plutonium in the high-level waste. (LK)

5350 (Y/OWI/TM—36/11) **Supplemental technical information in support of Y/OWI/TM—44. Volume 11. Drawings for repository preconceptual design studies: granite.** (Parsons, Brinckerhoff, Quade and Douglas, Inc., New York (USA)). Apr 1978. Contract W-7405-ENG-26. 184p. Dep. NTIS, MF A01.

Portions of document are illegible.

Volume 11 contains drawings of a preconceptual design for a nuclear waste storage facility in granite. Drawings are included for three fuel cycles: full recycle, throwaway fuel cycle, and uranium recycle with plutonium in the high-level waste. (LK)

5351 (Y/OWI/TM—36/15) **Supplemental technical information in support of Y/OWI/TM—44. Volume 15. Drawings for repository preconceptual design studies: basalt.** (Parsons, Brinckerhoff, Quade and Douglas, Inc., New York (USA)). Apr 1978. Contract W-7405-ENG-26. 372p. Dep. NTIS, PC A16/MF A01.

Volume 15 contains the drawings of a preconceptual design for a nuclear waste repository in basalt. Three fuel cycles are considered: fuel recycle, throwaway cycle, and uranium recycle with plutonium in the high-level wastes. (LK)

5352 (Y/OWI/TM—36/17) **Supplemental technical information in support of Y/OWI/TM—44. Volume 17. Drawings for repository preconceptual design studies: BPNL waste forms in salt.** (Parsons, Brinckerhoff, Quade and Douglas, Inc., New York (USA)). Apr 1978. Contract W-7405-ENG-26. 84p. Dep. NTIS, PC A05/MF A01.

Volume 17 contains drawings of a preconceptual design for a nuclear waste storage facility in salt. Three full cycles are considered: full recycle, throwaway cycle, and uranium recycle with plutonium in high-level waste. (LK)

5353 (Y/OWI/TM—36/22) **Technical support for GEIS: radioactive waste isolation in geologic formations. Volume 22. Nuclear considerations for repository design.** (Science Applications, Inc., Oak Ridge, TN (USA)). Apr 1978. Contract W-7405-ENG-26. 203p. Dep. NTIS, PC A10/MF A01.

This volume, Y/OWI/TM-36/22, "Nuclear Considerations for Repository Design," is one of a 23-volume series, "Technical Support for GEIS: Radioactive Waste Isolation in Geologic Formations," Y/OWI/TM-36, which supplements the "Contribution to Draft Generic Environmental Impact Statement on Commercial Waste Management: Radioactive Waste Isolation in Geologic Formations," Y/OWI/TM-44. The series provides a more complete technical basis for the preconceptual designs, resource requirements, and environmental source terms associated with isolating commercial LWR wastes in underground repositories in salt, granite, shale and basalt. Wastes are considered from three fuel cycles: uranium and plutonium recycling, no recycling of spent fuel and uranium-only recycling. Included in this volume are baseline design considerations such as characteristics of canisters, drums, casks, overpacks, and shipping containers; maximum allowable and actual decay-heat levels; and canister radiation levels. Other topics include safeguard and protection considerations; occupational radiation exposure including ALARA programs; shielding of canisters, transporters and forklift trucks; monitoring considerations; mine water treatment; canister integrity; and criticality calculations.

5354 (Y/OWI/TM—36/23) **Technical support for GEIS: radioactive waste isolation in geologic formations. Volume 23. Environmental effluent analyses.** (Science Applications, Inc., Oak Ridge, TN (USA)). Apr 1978. Contract W-7405-ENG-26. 130p. Dep. NTIS, PC A07/MF A01.

This volume, Y/OWI/TM-36/23, "Environmental Effluent Analysis," is one of a 23-volume series, "Technical Support for GEIS: Radioactive Waste Isolation in Geologic Formations," Y/OWI/TM-36, which supplements the "Contribution to Drat Generic Environmental Impact Statement on Commercial Waste Management: Radioactive Waste Isolation in Geologic Formations," Y/OWI/TM-44. The series provides a more complete technical basis for the preconceptual designs, resource requirements, and environmental source terms associated with isolating commercial LWR wastes in underground repositories in salt, granite, shale and basalt. Wastes are considered from three fuel cycles: uranium and plutonium recycling, no recycling of spent fuel and uranium-only recycling. This volume discusses the releases to the environment of radioactive and non-radioactive materials that arise during facility construction and waste handling operations, as well as releases that could occur in the event of an operational accident. The results of the analyses are presented along with a detailed description of the analytical methodologies employed.

5355 **Waste disposal concept for nuclear power stations in the Federal Republic of Germany.** Hildenbrand, G. (Kraftwerk Union, Erlangen, Ger). *Siemens-Z.;* **52**: No. 4, 168-177(Apr 1978). (In German).

The German concept of spent fuel disposal places particular emphasis on long-term environmental protection and on economical use of natural uranium resources. It has therefore been based on the fact that to solve these problems to optimum effect, spent fuel assemblies must be reprocessed and the contained plutonium must be recycled into light water or fast breeder reactors. The article describes the spent fuel disposal concept as well as the time schedule and interim solutions and gives comments on spent fuel disposal in other countries. 31 refs.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 5287, 5339, 5346, 5347, 5348, 5349, 5350, 5351, 5352, 5353, 5354, 6571, 6572, 6578, 6581

5356 (CONF-7710136—, pp 71-78) **Environmental effects of uranium exploration and mining.** Tibbs, N.H.; Rath, D.L.; Donovan, T.K. (Tennessee Valley Authority, Chattanooga). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Uranium exploration and mining is increasing as the Nation's demand for energy grows. The environmental impacts associated with this exploration and mining are not severe and compare favorably with impacts from the production of other energy resources.

5357 **Uranium radiation remedial action program to protect public health. Ninety-Fifth Congress, First Session, House of Representatives, September 29, 1977.** Washington, DC; Committee on Interstate and Foreign Commerce (1977). 8p. GPO.

The Committee on Interstate and Foreign Commerce, to whom was referred the bill (S.266) to amend Public Law 92-314 to authorize appropriations to the Energy Research and Development Administration for financial assistance to limit radiation exposure from uranium mill tailings used for construction, and for other purposes, having considered the same, reported favorably and recommended that the bill pass as amended. The need for the program arose from investigations early in the decade which revealed a potential health hazard caused by the widespread use of sand derived from uranium mill tailings for the construction of buildings in the Grand Junction, Colorado area. The construction sand has been taken from the site of an abandoned uranium mill which produced uranium for the Federal Government and was used in several hundred private and public buildings. Investigations revealed the potential for the entry into the structures of hazardous radon decay gas, which posed a public health hazard. S.266 extends the time for persons whose buildings were exposed to uranium mill tailings to file applications for remedial action for 4 more years after June 16, 1976; provides that persons who carried out such remedial action directly rather than waiting for it to be performed by the State of Colorado or its contractors may be reimbursed for the cost; provides that persons who in the future want to contract for such work may do so with advance approval of the State and the Secretary of Energy; requires a report on the program within 1 year after enactment of this bill; authorizes $1.5 million in additional appropriations for fiscal year 1979 for the program; and makes a number of technical amendments to title II of Public Law 92-314.

5358 Amending Public Law 92-314 authorizing appropriations to the Energy Research and Development Administration for financial assistance to limit radiation exposure from uranium mill tailings used for construction, and for other purposes. Ninety-Fifth Congress, First Session, House of Representatives, October 17, 1977. Washington, DC; Committee on Interior and Insular Affairs (1977). 10p. GPO.

The Committee on Interior and Insular Affairs, to whom was referred the bill (S. 266), to amend Public Law 92-314 to authorize appropriations to the Energy Research and Development Administration for financial assistance to limit radiation exposure from uranium mill tailings used for construction, and for other purposes, having considered the same, reported favorably and recommended that the bill pass as amended. The need for the program arose from investigations early in the decade which revealed a potential health hazard caused by the widespread use of sand derived from uranium mill tailings for the construction of buildings in the Grand Junction, Colorado area. The Committee on Interior and Insular Affairs recommended the adoption of its substitute amendment which: eliminates the $3 million authorization for fiscal year 1977, since that is no longer deemed necessary in light of the enactment of Public Law 95-3; authorizes the appropriation of $1.5 million for fiscal year 1979 to complete the remedial work which is now estimated to be required; extends the period during which persons may apply for remedial work on hazardous structures; requires that the modifications of contract authority of the State of Colorado contained in S. 266 be provided only in accord with section 401(a) of the Congressional Budget Act of 1974 so that payments may be made only as provided in appropriation acts; and conforms the original authorizing act with the recent congressional and Executive reorganizations.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 5312, 5357, 5358, 6573

5359 Skin diseases in uranium industry workers. Sevcova, M. *Cesk. Dermatol.;* **51**: No. 5, 318-322(1976). (In Czech).

Ten years of activity of the dermato-venerologic department of the Factory Centre of National Health of the uranium industry in Pribram is evaluated. In spite of some specific conditions of the working environment the chief problem of the plant dermatologist is the diagnosis and treatment of common dermatological diseases caused by dust, chemicals, rubber boots, excessive humidity in some places and the permanent presence of low-activity radioactive substances in the air and external ionizing radiation. Occupational diseases form a very small group of skin impairments—mostly allergic contact eczema of the lower limbs caused by rubber boots, chromium compounds during work with cement, blasting material and other allergens. The specificity of the job of the dermatologist here requires good knowledge of the working environment in view of the risk of ionizing radiation and its biological effects, especially the hazard of skin tumors following external exposure to alpha radiation from radon daughter products.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 5969, 6309, 6314

5360 (LA-UR—78-2238) **Portable neutron coincidence counter for assaying large plutonium samples.** Krick, M.S.; Evans, M.L.; Ensslin, N.; Hatcher, C.; Menlove, H.O.; Sapir, J.L.; Swansen, J.E.; de Carolis, M.; Ramalho, M. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 20p. (CONF-781007—5). Dep. NTIS, MF A01.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Portions of document are illegible.

A portable high-level neutron coincidence counter (HLNCC) has been developed for the assay of plutonium by inspectors of the International Atomic Energy Agency (IAEA). The counter is designed for the measurement of the effective ^{240}Pu mass in plutonium samples which may have a high plutonium content. The counter measures coincident fission neutrons in the presence of a random neutron background. Total plutonium content is calculated from the plutonium isotopic composition, which is either assumed to be known or is estimated from supplementary gamma-ray measurements made with a germanium detector. Correction procedures for removing nonlinearities in the counter response due to multiplication effects in the samples are being developed for plutonium metal and PuO_2 samples. The detector consists of 18 ^3He proportional counters embedded in six polyethylene slabs, which form an hexagonal well. Top and bottom end plugs can be used to form a closed sample-counting cavity. The detector weighs approximately 35 kg. A portable electronics package featuring shift-register coincidence counting electronics was designed for use with the detector; it includes all the electronic subsystems required for the operation of the counter except for the preamplifiers, which are mounted on the side of the detector. The electronics package is interfaced to a Hewlett-Packard HP-97 programmable calculator and to standard data communications devices. (7 figs.)

5361 (NUREG—0450(Ex.Summ.)) **Report of the Material Control and Material Accounting Task Force.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Mar 1978. 9p. NTIS $4.00.

In September 1977 a Task Force was formed to complete a study of the role of material control and material accounting in NRC's safeguards program. The Task Force's assignment was to: define the roles and objectives of material control and material accounting in the NRC safeguards program; recommend goals for the material control and material accounting systems based on their roles and objectives; assess the extent to which the existing safeguards regulatory base meets or provides the capability to meet the recommended goals; and provide direction for material control and material accounting development, including both near-term and long-term upgrades. The study was limited to domestic nuclear facilities possessing significant amounts of plutonium, uranium-233 or highly enriched uranium in unsealed form. The Task Force findings are reported.

5362 (RHO-CD—28(Rev.1)) **Source and special nuclear material sealing and labeling requirements.** Jordan, K.N. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Apr 1978. Contract EY-77-C-06-1030. 39p. Dep. NTIS, PC A03/MF A01.

Purpose of this document is to define requirements for the use of tamper-indicating seals and identifying labels on SS Material containers at Rockwell Hanford Operations. The requirements defined in this document are applicable to all Rockwell Hanford Operation employees involved in handling, processing, packaging, transferring, shipping, receiving or storing SS Material.

5363 (Y/DA—7740) **Developmental aspects of a dynamic special nuclear materials control and accountability system.** Bowers, G.L.; Darby, D.M.; Dunigan, T.H.; Sampson, T.E.; Cochran, J.L. (Oak Ridge Y-12 Plant, TN (USA)). 1978. Contract W-7405-ENG-26. 6p. (CONF-781007—9). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Three aspects of the Dynamic Special Nuclear Materials Control and Accountability System (DYMCAS) effort in the Y-12 Plant are addressed. A broad overview of the system's features is followed by a discussion of the DYMCAS prototype work done in support of the final DYMCAS design. Also discussed is the nondestructive assay effort (NDA) in determining specific NDA requirements, operating procedures, standards development, and instrumentation precision. (LK)

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 6011

5364 (CONF-7710136—, pp 270-279) **Plutonium assessment modeling: government policy, non-proliferation, and the government fence.** Kurstedt, H.A. Jr.; Nachlas, J.A. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Assessment modeling for the evaluation of plutonium as an energy resource is stressed, and generic mathematical model forms are outlined. Representative necessary objective functions are developed. Constraints and assumptions are listed. An example involving present-day light water reactor technology is demonstrated. Technical, environmental, and political implications are drawn. Specific new directions for analysis are suggested. The position of the boundary of government control and responsibility--the government exclusion fence--is shown to be a critical, but overlooked, constraint. Existing governmental uranium stockpiles may be an unmentioned, though important, constraint. Plutonium is the most abundant proven energy equivalent and most controversial energy resource. Plutonium results from an intermediate nuclear reactor processing stage starting with the raw material ^{238}U. Therefore, the plutonium resource differs from the ^{238}U resource only through minimal conversion losses and through the political and/or social will to perform the conversion. The relative abundance of ^{238}U, and therefore of plutonium is high. There is a great need to assess plutonium in relation to the potential available energy for a society in short supply.

5365 **Public participation in the United States nuclear export process.** Stoiber, C.R. (Nuclear Regulatory Commission, Washington, DC). *At. Energy Law J.;* **18**: No. 3, 169-201(Fal 1976).

Discussions are presented that demonstrate three major avenues for public participation in decision making on nuclear exports. Attempts are made to evaluate each of these mechanisms to determine which of them may have potential for contributing to the rational and orderly conduct of the nation's foreign nuclear commerce. The three avenues discussed are participation through export licensing (public hearings of the Nuclear Regulatory Commission), through National Environmental Policy Act procedures, and through the congressional process. Examples of public participation through each of these avenues are cited.

FUSION FUELS

BY-PRODUCTS

REFER ALSO TO CITATION(S) 5372, 5373, 5375

5366 **Production of synthetic methanol from air and water using controlled thermonuclear reactor power. 2. Capital investment and production costs.** Dang, V.D.; Steinberg, M. (Brookhaven National Lab., Upton, N.Y. (USA)). *Energy Convers.;* **17**: No. 4, 133-140(1977).

Energy requirement and process development of methanol production from air and water using controlled thermonuclear fusion power was discussed in Part 1 (Steinberg et al., Energy conversion;17:97(1977)). This second part presents an economic analysis of the nine processes presented for obtaining carbon dioxide recovery from the atmosphere or the sea for methanol production. It is found that the most economical process of obtaining carbon dioxide is by stripping from sea water. The process of absorption/stripping by dilute potassium carbonate solution is found to be the most economical for the extraction of carbon dioxide from air at atmospheric pressure. The total energy required for methanol synthesis from these sources of carbon dioxide is 3.90 kWh(e)/lb methanol of which 90% is used for generation of hydrogen. The process which consumes the greatest amount of energy is the absorption/stripping of air by water at high pressure and amounts to 13.2 kWh(e)/lb methanol. With nuclear fusion power plants of 1000to 9000 MW(e), it is found that the cost of methanol using the extraction of carbon dioxide from air with dilute potassium carbonate solution is estimated to be in the range between Pound1.73 and Pound2.90/MMB.t.u. (energy equivalent - 1974 cost) for plant capacities of 21 400 to 193 000 bbl/day methanol. This methanol cost is competitive with gasoline in the range of 19 approximately equal to 33c/gallon. For the process of stripping of carbon dioxide from sea water, the cost is found to lie in the range of Pound1.65 to Pound2.71/MMB.t.u. (energy equivalent) for plant capacities of 21 700 to 195 000 bbl/day methanol which is competitive with gasoline in the range of 18 approximately equal to 30 c/gallon. Projection of methanol demand in the year 2020 is presented based on both its conventional use as chemicals and as a liquid fuel substituting for oil and gas.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

5367 (ORNL—5383, pp 68-72) **Special isotope production and separations.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

Program activities are discussed under the following topics: Transuranium Processing Plant operations; special projects; stable isotope operations; and separator research and development. (RCK)

5368 **Assembly of tubes for isotopic separation diffusers.** Dussaussoy, P.; Mongin, P.; Rouviere, R.; Simon, G. (to Commissariat a l'Energie Atomique). US Patent 4,092,135. 30 May 1978. Priority date 10 Aug 1972, France. 4p.

A tube assembly for use in isotopic separation diffusers is described. Each tube assembly is secured at each end to an end-plate and comprises a number of filter tubes assembled by fitting together adjacent ends which are provided with inter-fitting spigots having a diameter greater than that of the body of the tube. The assembled tubes are connected together in bundles by means of resilient means located at the level of the spigots so that the tubes make contact with each other via the abutting spigots.

5369 **Laser-induced separation of hydrogen isotopes in the liquid phase.** Freund, S.M.; Maier, W.B. II; Beattie, W.H.; Holland, R.F. (to Dept. of Energy). US Patent Application 839,238. 4 Oct 1977. 14p.

Hydrogen isotope separation is achieved by either (1) dissolving a hydrogen-bearing feedstock compound in a liquid solvent, or (2) liquefying a hydrogen-bearing feedstock compound, the liquid phase thus resulting being kept at a temperature at which spectral features of the feedstock relating to a particular hydrogen isotope are resolved, i.e., a clear-cut isotope shift is delineated, irradiating the liquid phase with monochromatic radiation of a wavelength which at least preferentially excites those molecules of the feedstock containing a first hydrogen isotope, inducing photochemical reaction in the excited molecules, and separating the reaction product containing the first isotope from the liquid phase.

OTHER INDUSTRIAL USES

REFER ALSO TO CITATION(S) 6770

ISOTOPIC POWER SUPPLIES

5370 **Thermal shunt for radioisotope thermoelectric generator-chemical battery hybrid configuration.** Guazzoni, G.E. (to Secretary of the Army). US Patent 4,097,654. 27 Jun 1978. Filed date 14 Apr 1977. 4p.

A thermal shunt is provided to recover the rejected heat from a radioisotope thermoelectric generator utilized in a hybrid configuration with a chemical battery to maintain the chemical battery at a temperature above the environmental ambient temperature.

DESIGN AND FABRICATION

5371 (PNL—1845-39) **Quarterly report on the strontium heat source development program, Advanced Systems and Materials Production Division for April—June 1978.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1978. Contract EY-76-C-06-1830. 21p. Dep. NTIS, PC A02/MF A01.

All of the remaining compatibility tests are proceeding as scheduled. Results of the 20,000-hr compatibility tests with nonradioactive SrF_2 show that, with one exception, attack of the specimens by the SrF_2 after 20,000 hr is no greater than after 6000 and 12,000 hr. The one exception involved Haynes Alloy 25 specimens tested at 1000°C. These test specimens exhibited isolated subsurface voids to depths of 0.025 in., although the general surface attack was only about 0.001 inches. The cause of the void formation has not yet been determined. Tests with Hastelloy S and Hastelloy C-4 at 600 to 800°C for 2500 hr show that oxidation of the two alloys adheres to the parabolic rate law. Both alloys from adherent oxide layers over the temperature range of interest. Intergranular attack, pitting, and subsurface void formation increase sharply with increased oxidation

temperature with both alloys, and at 800°C the depth of metal exhibiting oxidation damage is several times greater than the thickness of the oxide layer.

HYDROGEN

PRODUCTION

REFER ALSO TO CITATION(S) 5397, 5452, 5843

5372 (CONF-771203—, pp 295-296) **Production of synthetic fuels: an important civilian application of laser fusion.** Gomberg, H.J.; Meinke, W.W. (KMS Fusion, Inc., Ann Arbor, MI). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5373 (CONF-771203—, pp 297-298) **Magnetic fusion energy as user and producer of hydrogen.** Cullingford, H.S.; Bogart, S.L.; Williams, J.M. (Energy Research and Development Administration, Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5374 **Fuel hydrogen--its promises, problems and prospects.** Sastri, M.V.C. (Indian Inst of Technol, Madras). *Chem. Age India;* **29**: No. 2, 85-95(Feb 1978).

The author first considers hydrogen from the viewpoint as an alternative to the disappearing fossil fuels. Hydrogen as energy carrier is then examined. The production of hydrogen via processes using nuclear energy and solar energy are examined. Photosynthetic methods of hydrogen production are also outlined. Hydrogen transmission and safety aspects in handling hydrogen are also given.

ELECTROLYSIS

REFER ALSO TO CITATION(S) 4972, 5524, 5684, 5685

5375 (BNL—24669) **Synfuels production from fusion reactors.** Fillo, J.A.; Powell, J.R.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). [nd]. Contract EY-76-C-02-0016. 10p. (CONF-780508—71). Dep. NTIS, MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

Portions of document are illegible.

The decreasing availability of fossil fuels emphasizes the need to develop systems which will produce synthetic fuel to substitute for and supplement the natural supply. An important first step in the synthesis of liquid and gaseous fuels is the production of hydrogen. Thermonuclear fusion offers an inexhaustible source of energy for the production of hydrogen from water. Depending on design, electric generation efficiencies of approximately 40 to 60 percent and hydrogen production efficiencies by high temperature electrolysis of approximately 50 to 70 percent are projected for fusion reactors using high temperature blankets.

5376 (CONF-771203—, pp 307-308) **State of development in the area of water electrolysis (near term).** Lu, P.W.T.; Srinivasan, S. (Brookhaven National Lab., Upton, NY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5377 (CONF-771203—, pp 529-531) **Hydrogen production with the sulfur cycle water decomposition system.** Farbman, G.H. (Westinghouse Electric Corp., Pittsburgh). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5378 (CONF-771203—, pp 533-535) **New electrolytic cell type for hydrogen production in hybrid cycles.** Schuetz, G.H.; Lalonde, D. (Joint Research Centre of the European Communities, Ispra, Italy). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5379 (CONF-771203—, pp 541-542) **Highly efficient thermochemical cycle for hydrogen production.** Soliman, M.A. (Univ. of Riyadh, Saudia Arabia). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5380 (CONF-771203—, pp 549-551) **Chemical storage of solar energy as hydrogen through photoelectrolysis of water.** Sastri, M.V.C.; Subba Rao, G.V. (Indian Inst. of Tech., Madras). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5381 (CONF-771203—, pp 625) **Liquid hydrogen from solar energy now.** Zachmann, H.C. (Associated Enterprises, Ellicott City, MD). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 5366, 5379

5382 (CONF-771203—, pp 309-311) **Status of the ERDA (STOR)-sponsored national program on hydrogen production from water via thermochemical cycles.** Baker, C.E. (Lewis Research Center-NASA, Cleveland); Berger, B.J. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5383 (CONF-771203—, pp 537-539) **Water splitting: the chemistry of the I_2—SO_2—H_2O reaction and the processing of H_2SO_4 and HI products.** Norman, J.H.; Mysels, M.J.; O'Keefe, D.R.; Stowell, S.A.; Williamson, D.G. (General Atomic Co., San Diego, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5384 (CONF-771203—, pp 543-545) **Thermochemical water splitting process using iron—copper chlorine cycle.** Sasaki, A.; Tamai, M.; Masai, K.; Sato, F. (Hiroshima Technical Inst.). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5385 (CONF-780807—10) **Recent research on themochemical hydrogen production at the Oak Ridge National Laboratory.** Bamberger, C.E.; Richardson, D.M. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From 2. world hydrogen energy conference; Zurich, Switzerland (21 Aug 1978).

Continuing efforts on the identification and determination of chemical feasibility of thermochemical cycles for the production of hydrogen from water have recently resulted in two new cycles. The reactions involved have been demonstrated experimentally. One cycle consists of essentially three reactions: (1) the oxidation of Co(II), as CoO, by barium hydroxide to a compound containing barium and Co(II,IV) while evolving hydrogen, (2) the hydrolysis of the compound to $Ba(OH)_2$, which is water soluble, and Co_3O_4, and (3) the thermal decomposition of Co_3O_4 to CoO and oxygen. At least two new barium-cobalt compounds can be produced by reaction (1) depending on the initial Ba/Co ratios; however, on hydrolysis they yield the same products. This cycle appears to be quite simple and can be effected at reasonable temperatures. The second cycle involves essentially five chemical reactions. The first reaction is new and consists of the oxidation of metallic copper by barium hydroxide

to a double oxide of copper(I) and barium while evolving hydrogen. Reaction 2 consists of the hydrolysis of the double oxide into barium hydroxide and copper(I) oxide. Copper(I) oxide is then reacted with aqueous HF to yield copper(II) fluoride and metallic copper. The fourth reaction involves the pyrohydrolysis of copper fluoride to copper(II) oxide. The cycle is closed with the thermal decomposition of copper(II) oxide. Although this cycle comprises five chemical reactions, they are quite simple and do not involve difficult separation procedures. The fluorine compounds are involved only in reactions that proceed at relatively low temperatures and thus do not appear to pose intractable corrosion problems. Experimental data on the above reactions and structural data on some of the new compounds are presented.

5386 (CONF-780807—11) **Experimental verification of the mercury—iodine thermochemical cycle for the production of hydrogen from water, ANL-4.** Appelman, E.H.; Schreiner, F.; Abraham, B.M. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 58p. Dep. NTIS, PC A04/MF A01.

From 2. world hydrogen energy conference; Zurich, Switzerland (21 Aug 1978).

The thermochemical hydrogen-producing cycle ANL-4 consists of the reactions: $2NH_3 + 2KI + 2CO_2 + 2H_2O \rightarrow 2NH_4I + 2KHCO_3$, $2KHCO_3 \rightarrow K_2CO_3 + CO_2 + H_2O$, $Hg + 2NH_4I \rightarrow 2NH_3 + HgI_2 + H_2$, and $HgI_2 + K_2CO_3 \rightarrow 2KI + Hg + CO_2 + 1/2O_2$. The maximum temperature required by the cycle is 1000 K. The calcination reaction is well-known to take place around 475 K and has been described in the literature. The other three reactions have been subjected to experimental verification, and yields and reaction rates have been measured. A flow diagram for the cycle has been constructed, and an overall practical efficiency of 28% in terms of ΔG/sub f/(H_2O)/(total heat input) has been estimated from the new data. A substantial portion of the total heat input is required for the isolation of the ammonium iodide. Our results indicate that the cycle should be capable of producing hydrogen from water with reasonable efficiency and without requiring heat at an unduly high temperature. The cycle should therefore be suitable for a practical demonstration of the technical feasibility of thermochemical hydrogen generation.

5387 **Thermodynamic losses in thermochemical cycles for hydrogen production.** Deneuve, F. *Rev. Gen. Therm.;* **17**: No. 197, 435-436(May 1978).

Energy evaluations made by Gaz de France of the various possible thermochemical cycles are described. (LK)

5388 **Hydrogen production from water by means of chemical cycles.** Glandt, E.D.; Myers, A.L. *Ind. Eng. Chem., Process Des. Dev.;* **15**: 100-108(Jan 1976).

Its theoretical search for an optimum closed-cycle thermochemical process for the production of hydrogen has led the University of Pennsylvania to the tentative conclusion that, as previous research has shown for 2-step cycles, a workable 3-step cycle probably does not exist. Because economics impose a severe restriction on the allowable number of reaction steps, a thermochemical process involving four or more reactions cannot successfully compete with direct electrolysis for hydrogen production. The conclusion is based on a systematic thermodynamic analysis of the simplest and most promising 3-step processes that have been proposed and several 4-step cycles that can be considered as extensions of 3-step patterns.

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 4944, 5494, 5506

5389 (CONF-771203—, pp 877-888) **Biocatalytic production of hydrogen gas by an in vitro system.** Hall, D.O.; Rao, K.K.; Reeves, S.G.; Gogotov, I.N. (King's Coll., London). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5390 (CONF-780549—3) **Use of cell-free biological systems for hydrogen production.** Egan, B.Z.; Scott, C.D. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

From Symposium on biotechnology in energy production; Gatlinburg, TN, USA (10 May 1978).

Portions of document are illegible.

Conceptual processes for the production of hydrogen from water using cell-free biological systems are analyzed. Proposed flowsheets include the chemical reduction of ferredoxin (the electron transport medium) or the photochemical reducing potential of illuminated chloroplasts for ferredoxin reduction, followed by the reaction of reduced ferredoxin with protons, catalyzed by hydrogenase, to produce hydrogen gas. Factors affecting hydrogen production rates are discussed. The optimum temperature for the ferredoxin-hydrogenase enzyme system is 40 to 45°C. The rate of reduction of ferredoxin by dithionite was measured spectrophotometrically, and kinetic parameters were evaluated. The kinetics of ferredoxin oxidation by molecular oxygen is discussed, and possible methods for oxygen removal are considered. Various methods for enzyme immobilization were studied in terms of applicability to a continuous process for hydrogen production.

STORAGE

5391 (CONF-771203—, pp 557-559) **Potential of zeolite molecular sieves as hydrogen storage media.** Fraenkel, D.; Shabtai, J. (Weizmann Inst. of Science, Rehovot, Israel). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

CHEMISORPTION

5392 (BNL—24735) **Hydrogen storage technology for metal hydrides.** Strickland, G. (Brookhaven National Lab., Upton, NY (USA)). Jun 1978. Contract EY-76-C-02-0016. 34p. (CONF-780748—1). Dep. NTIS, PC A03/MF A01.

From Hydrogen for energy distribution; Chicago, IL, USA (24 Jul 1978).

The advantages of using hydrogen as a secondary energy carrier are stated, and numerous factors pertinent to the technology of hydrogen storage via metal hydrides are briefly described. The technology is centered on iron-titanium hydride, FeTiH/sub x/, as the most practical choice for the safe and compact storage of hydrogen. Uses of hydride hydrogen as a fuel or energy carrier are given. The features of hydride reservoir designs are explained, and some performance data are given for two reservoirs constructed at BNL. Results of tests on the long-term behavior of FeTiH/sub x/ are presented along with information on pressure drop in a hydride bed. Two methods of accommodating hydride expansion are described. Other topics include: container materials selection, safety testing of FeTiH/sub x/, hydride materials development, storage systems work at BNL, the proposed Hydrogen-Halogen Energy Storage System, a proposed technique of storing hydrogen in hollow glass microspheres at very high pressure, and information on the commercial availability of materials and equipment for hydride hydrogen. Current development needs are included in the various sections.

5393 (CONF-771203—, pp 315-317) **State-of-the-art summary of the technical problems involved in the storage of hydrogen via metal hydrides.** Strickland, G. (Brookhaven National Lab., Upton, NY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5394 (CONF-771203—, pp 547-548) **Survey of the hydrogen storage properties of nickel—copper—mischmetal—calcium alloys.** Sandrock, G.D. (International Nickel Co., Inc., Suffern, NY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5395 (CONF-771203—, pp 553-554) **Use of manganese substituted ferrotitanium alloys for energy storage.** Johnson, J.R.; Reilly, J.J. (Brookhaven National Lab., Upton, NY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5396 (CONF-771203—, pp 555) **Modification of hydriding properties of AB_5-type hexagonal alloys through manganese substitution.** Lundin, C.E.; Lynch, F.E. (Univ. of Denver). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

TRANSPORT

REFER ALSO TO CITATION(S) 5374, 5843

MARKETING AND ECONOMICS

5397 (CONF-771203—, pp 313-314) **Production economics for hydrogen, ammonia, and methanol during the 1980—2000 period.** Corneil, H.G.; Heinzelmann, F.J.; Nicholson, E.W.S. (Exxon Research and Engineering Co., Linden, NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

SAFETY

5398 (COO—4442-3) **Comparative analysis of hydrogen fire and explosion incidents. Progress report No. 3, March 1, 1978—June 30, 1978.** Zalosh, R.G.; Short, T.P.; Marlin, P.G.; Coughlin, D.A. (Factory Mutual Research Corp., Norwood, MA (USA)). Jul 1978. Contract EE-77-C-02-4442. 36p. Dep. NTIS, PC A03/MF A01.

Approximately 140 additional hydrogen incident reports have been compiled during this reporting period to increase the total number of reports to about 420. A preliminary analysis of the data shows that 60 percent of the reported incidents have been hydrogen explosions and that 82% of the casualties have been due to explosions. Inadequate hydrogen detection of leaks, incomplete purging, etc., was a primary cause factor in 36% of the incidents. Recommendations are presented for research in explosion protection, hydrogen leak and flame detection, and ignition sources associated with high speed emergency releases of hydrogen. A multivariate regression analysis has been conducted to compare the severity of hydrogen and natural gas losses at Factory Mutual insured plants. The results indicate that, after accounting for the effects of deductibles, occupancy type and inflation, there is no statistically significant difference between the severity of hydrogen and natural gas losses. A simple calculation of the frequency of hydrogen and natural gas incidents at ferrous metal processing plants indicates that there have been significantly more hydrogen incidents per unit volume or per unit energy of gas consumed. A similar calculation is presented for petroleum refinery incidents, but with less conclusive results.

INDUSTRIAL AND COMMERCIAL USE

5399 (CONF-771203—, pp 305-306) **Hydrogen as a mid-term gaseous fuel supplement by blending with natural gas.** Steinmetz, G.F. (Baltimore Gas and Electric Co.). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5400 (CONF-771203—, pp 319-321) **Hydrogen-powered homestead.** Billings, R.E. (Billings Energy Corp., Provo, UT). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5401 (CONF-771203—, pp 323-325) **Self-propelled hydrogen-powered refrigerator car.** Whitelaw, R.L. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

PROPERTIES

REFER ALSO TO CITATION(S) 6383

OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 5504

HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 5524

PROPERTIES

REFER ALSO TO CITATION(S) 5239, 6214

5402 (EPA—600/7-77-073d, pp 139-181) **Chemical reactions in the conversion of fuel nitrogen to NO/sub x/: low-pressure flat-flame burner studies.** Kahn, D.R.; Axworthy, A.E. (Rockwell International, Canoga Park, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

The objective of this study is to use a low-pressure, premixed, flat-flame burner as a tool for investigating the mechanism and kinetics of the chemical reactions involved in the formation of NO/sub x/ in the combustion of fossil fuels or alternate fuels derived from fossil fuels. A detailed probing study of a CH_4—O_2—N_2 flame at 0.1 atm was conducted with the addition of 50 ppM of NH_3 or HCN to the feed gas. These additives were used to simulate the expected products of preflame reactions of the fuel nitrogen species that are contained in coals and residual fuel oils (mainly heterocyclic aromatic compounds). An experimental procedure was developed that permitted NO, NO_2, NH_3, and HCN to be measured independently below, in, and above a low-pressure flame. The methane flame experiments were carried out under fuel-rich (phi = 1.5) and fuel-lean (phi = 0.8) conditions at a diluent ratio of 0.7 with and without the addition of NH_3 or HCN. The formation of "thermal" NO/sub x/ from N_2 (via both the Zeldovich and "prompt" paths) was compared directly with the formation of "fuel" NO/sub x/ from the added NH_3 or HCN. In all cases, thermal (prompt) NO and fuel NO formed very rapidly at approximately the same location just above the top of the luminous zone, and the amounts formed were approximately additive. In fuel-rich flames, both prompt NO and fuel NO appeared to form almost exclusively via HCN as an intermediate. In a similar study of NO/sub x/ formation in the fuel-rich flame of a simulated low-Btu fuel (a mixture of hydrogen and carbon monoxide), NO formed from added NH_3 in high yield but more than one-half of this NO was consumed just above the luminous zone. Only 20 percent of added NO was consumed in the absence of added NH_3.

5403 (EPA—600/7-77-073d, pp 311-351) **Premixed one-dimensional flame (PROF) code development and application.** Kelly, J.T.; Kendall, R.M. (Acurex Corp., Mountain View, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

The PRemixed One-Dimensional Flame (PROF) code numerically models complex chemistry and diffusion processes in premixed flames. Since the code includes diffusion, realistic solutions of coupled combustion and pollutant formation processes can be obtained in the flame zone, as well as downstream in the post-flame region. Previous experience has shown that the code can be a valuable aid when analyzing experimentally-found coupled combustion and pollutant formation phenomena such as "PROMPT NO." The code's accuracy and reliability has now been increased. Also, several models for heat loss to bounding walls have been added to the code to model confined flames, such as those occurring in surface and catalytic combustors. Also, plug and well-stirred reactor options have been added to model combustion and pollutant formation processes in a wide variety of conventional and experimental combustion systems. Sample calculations are presented to demonstrate the capabilities of the revised PROF code. Also, to illustrate the value of the code in analyzing complex combustion and pollutant formation processes, predictions of NO formation in premixed CH_4/air flames over a wide range of equivalence ratios are presented. These calculations show that the well-known extended Zeldovich mechanism is adequate for stoichiometric and lean conditions, but inadequate under fuel-rich conditions. A possible fuel-rich NO mechanism is then postulated to account for NO formation at equivalence ratios greater than one.

5404 (UCRL—80832) **Modeling study of flame structure in low-pressure, laminar, pre-mixed methane flames.** Creighton, J.R.; Lund, C.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1978. Contract W-7405-ENG-48. 40p. (CONF-780941—1). Dep. NTIS, PC A03/MF A01.

From 10. materials research symposium; Gaithersburg, MD, USA (18 Sep 1978).

Low pressure, laminar, methane flames were modeled numerically using a fully implicit, one-dimensional flame code with detailed chemical kinetics and adaptive gridding. Calculated major species profiles were in good agreement with experiment; and most radical and intermediate species showed fair to good agreement. The calculated flame velocity was about half of experimental and was insensitive to variation of species diffusion coefficients and chemical reaction rate constants except decomposition of HCO. Quadrupling that rate constant improved the calculated flame velocity, as well as radical species profiles. Insight was gained into the physical and chemical processes governing flame propagation.

5405 **Oxidation of hydrocarbon jet fuels at different temperatures.** Gureev, A.A.; Chertkova, N.Ya. *Khim. Tekhnol. Topliv Masel;* No. 3, 38-41(1977). (In Russian).

The oxidation of three jet fuels by molecular oxygen was studied at temperatures from 90 to 150°C. The dependence of the induction period for oxidation and of the oxidation rate on temperature was determined. The absorption spectra of the oxidation products were obtained and the kinetics of their appearance was correlated with the oxygen consumed. (JSR)

PREPARATION

5406 **Future processes for the production of SNG.** Stroud, H.J.F. *Gas Eng. Manage.;* **17**: No. 10, 355-366(Oct 1977).

A range of possible future processes for producing SNG is described, particular emphasis being given to the use of nuclear energy to reduce the amount of fossil fuels necessary to make base-load SNG. The advantages of making SNG instead of changing to a hydrogen economy are shown.

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 5534

5407 (CONF-771203—, pp 703-705) **Peat gasification for SNG production.** Punwani, D.W. (Inst. of Gas Tech., Chicago); Bodle, W.W.; Rader, A.M.; Tarman, P.B. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5408 **Fischer—Tropsch reaction studies with supported ruthenium catalysts. I. Product distributions at moderate pressures and catalyst deactivation.** Everson, R.C.; Woodburn, E.T.; Kirk, A.R.M. (Univ. of Natal, Durban, South Africa). *J. Catal.;* **53**: No. 2, 186-197(30 Jun 1978).

Hydrocarbon systhesis especially in the range C_5-C_{12} using 0.5% ruthenium-on-alumina pellets at elevated pressures (8 to 16 bar) was undertaken. For this purpose a stirred gas-solid reactor was used together with a gas chromatograph fitted with an on-line hot sampling valve for a complete product analysis up to C_{12}. Product spectra consisting mainly of saturated hydrocarbons and with C_5-C_{12} fractions of the order of 23.3 to 26.9 mol% (of total hydrocarbons) or 54.0 to 59.5 wt% (assuming saturated hydrocarbons only) were obtained at temperatures close to 500 K. At 550 K and higher, there appears to be a critical space velocity for an optimum yield of C_5-C_{12}. The selectivity of the hydrocarbons leaving the reactor was found to be influenced by the partial pressure of the carbon monoxide inside the reactor. Some catalyst characterizations are also presented, such as carbon burn-off and BET areas, obtained from samples taken at instants when product analyses were performed. 5 tables, 9 figures.

5409 **Rhodium-based catalysts for the conversion of synthesis gas to two-carbon chemicals.** Ellgen, P.C.; Bartley, W.J.; Bhasin, M.M.; Wilson, T.P. (Union Carbide Corp, South Charleston, WVa). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 616-623(Mar 1978).

The results of kinetic studies are described for synthesis gas conversion over rhodium and rhodium-manganese catalysts. These results are compared to those available in the literature for related systems and some mechanistic speculations are presented. Results show that rhodium-based catalysts exhibit hitherto unsuspected abilities to convert synthesis gas in one step to C_2 chemicals, predominantly acetic acid and acetaldehyde, at temperatures around 300°C and pressures of 30-100 atmospheres. Addition of small quantities of manganese to these catalysts results in up to a ten-fold increase in the synthesis rate, but relatively little change in the product distribution. The rate of production of methane plus C_2 chemicals at high but not at low pressures by these catalysts can be attributed to the greater importance of CO insertion into Rb-CH_3 bonds at the higher pressures. 16 refs.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 4973, 5495, 5498, 5499, 5501, 5502

5410 (BNWL-SA—6485) **Low molecular weight products from the aqueous alkaline degradation of cellulose.** Molton, P.M.; Miller, R.K.; Donovan, J.M.; Demmitt, T.F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1977. Contract EY-76-C-06-1830. 44p. (CONF-771181—1). Dep. NTIS, PC A03/MF A01.

From Seminar on thermochemical conversion of biomass residues; Richland, WA, USA (29 Nov 1977).

Low molecular weight products from the degradation of pure cellulose in 0.6 to 1.3 N alkali at 300°C were identified by gas chromatography/mass spectrometry (GC/MS). Both the aqueous residual phase and the floating oil product phase were examined, and found to contain essentially the same compounds. Derivatization by trifluoroacetic anhydride was used as an ancillary method to aid identification of these compounds, which consisted primarily of unsaturated aliphatic and alicyclic hydrocarbons, aldehydes, ketones, alcohols, and furans. Many isomers were present. Specific compounds identified with a high level of confidence were cyclopentanone, cyclohexanone, phenol, cresols, 2-ethylcyclopentanone, 2- or 3-methylcyclopentanone, 2,5-dimethyl-2-cylopentenone, acrolein, 2,5-dimethyl-2,4-hexadiene, and octene. Compounds identified with a lower level of confidence include 2,4-dimethylfuran, 2,5-diethylfuran, ethylmethylfuran, 4-octyne, and decyne. The formation of these compounds from cellulose under alkaline conditions demonstrates not only the degradation of cellulose, but the resynthesis of molecules with carbon chain lengths greater than 6 atoms (the chain length of glucose). Such resynthesis must occur to a great extent in the formation of insoluble high molecular weight oils from cellulose by heating in aqueous alkali.

5411 (CONF-771203—, pp 867-869) **Synthetic gas from municipal refuse will provide total power demand for a major wastewater reclamation plant.** Aberley, R.C.; Sieger, R.B.; Bracken, B.D. (Brown and Caldwell, Walnut Creek, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5412 (CONF-771203—, pp 873-875) **Garrett energy research biomass gasification process.** Garrett, D.E.; Vatcha, S.R. (Garrett Energy Research and Engineering Inc., Claremont, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5413 (CONF-7710136—, pp 221-229) **Steam raising with low-Btu gas generators and potential for other applications.** Williams, R.O. (Univ. of California, Davis); Goss, J.R.; Horsfield, B.C.; Hodam, R. 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

A pilot-plant gas producer was installed at a walnut processing plant to recover usable energy from cracked walnut shell. The shell was converted to a low-Btu fuel gas (producer gas) and this was used to replace natural gas in a steam boiler. Long-term continuous operation of the producer has yet to be achieved due to mechanical inadequacies of the fuel feed and grate systems. These problems are a result of special fuel characteristics of walnut shell, which are being further investigated on a laboratory-scale gasifier. It is expected that component changes and/or fuel preparation can facilitate satisfactory long-term operation.

5414 (COO—2900-15) **Fast production of methane by anaerobic digestion. Progress report, March 7, 1978—April 6, 1978.** Finney, C.D.; Evans, R.S. II; Finney, K.A. (Natural Dynamics, Des Moines, IA (USA)). Apr 1978. Contract EY-76-C-02-2900. 21p. Dep. NTIS, PC A02/MF A01.

Comprehensive tables of the comparative daily performance of the digesting systems are continued. The maximal rate of production of volatile acids from Ames RDF was 0.5 to 1.0 g l^{-1} day^{-1} as acetic with a maximal yield of 12 g l^{-1}. Changes in gas production,

pH, volatile acids, organic nitrogen, and total nitrogen as functions of agitation and loading were measured. Plots of gas production and nitrogen are insensitive to agitational rate. However, as loading was increased, both volatile acids and pH were more stable at the highest agitational speed. The differences in stability correspond qualitatively with the rate coefficients for the disappearance of volatile acids that were reported previously.

5415 (COO—2917-10) **Biological conversion of biomass to methane. Quarterly progress report, January 21—April 30, 1978.** Pfeffer, J.T. (Illinois Univ., Urbana (USA). Dept. of Civil Engineering). May 1978. Contract EY-76-S-02-2917. 27p. Dep. NTIS, PC A03/MF A01.

The results of a series of tests to evaluate the methane yield from the anaerobic digestion of corn stover are reported. The corn stover, consisting of cob, stalks, and leaves, was milled to pass through a 3.2 mm screen. Particle size distributions were determined. Data are tabulated on the gas production. Centrifugation and vacuum filtration were investigated for slurry dewatering. Gas production was low and corn stover does not appear to offer any potential as a methane source. In addition the protein content of the slurry solids was not sufficient for a satisfactory protein animal feed. (JSR)

5416 (COO—2981-7) **Anaerobic fermentation of agricultural residues: potential for improvement and implementation. Seventh quarter progress report, December 16, 1977—March 15, 1978.** Jewell, W.J.; Guest, R.W.; Loehr, R.C.; Price, D.R.; Gunkel, W.W.; Van Soest, P.J. (Cornell Univ., Ithaca, NY (USA). Coll. of Agriculture and Life Sciences). 1978. Contract EY-76-S-02-2981. 34p. Dep. NTIS, PC A03/MF A01.

This is the seventh progress report of an on-going three year research effort to contribute to the development of a new and/or improved technology that will result in wide spread use of an anaerobic fermentation in agriculture to generate a renewable clean energy source. Activities are now concentrating on full-scale and pilot-scale demonstration of simplified fermentors for manures. Activities for the seventh quarter year, extending from December 16, 1977 to March 15, 1978, have included the following: completion of construction of the full scale conventional control fermenter; completion of construction, testing and startup of the random mix fermenter; installation of feed and effluent lines, electrical wiring, boilers, gas lines and controls; successful testing of the ram pump; conclusion of the 35°C studies with the pilot scale plug flow fermenter and the initiation of the low temperature (25°C) studies; and preparation of a detailed outline to the design manual. As of March 15, 1978, the overall progress achieved with the major components of the project was estimated to be about 2.5 months behind the work plan schedule. As detailed in the last progress report, much of this delay has been due to the winter weather (i.e., cold temperatures, snow, frozen ground, etc.) which has interfered with excavation and other outdoor construction activities.

5417 (COO—2991-28) **Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.** Wise, D.L.; Wentworth, R.L. (Dynatech R/D Co., Cambridge, MA (USA)). 27 Jan 1978. Contract EY-76-C-02-2991. 156p. Dep. NTIS, PC A08/MF A01.

A regular coordination meeting, the seventh in a quarterly series, was held of the "methane production" group of the Fuels from Biomass Systems Branch, U.S. Department of Energy. The meeting was held in Seattle, Washington in order to site visit the Monroe, Washington anaerobic digester facility operated by Ecotope Group, Inc. In addition, progress reports were presented from all contractors. A list of attendees, the working schedule, and the progress reports and special topical reports presented are included in the following. Separate abstracts were prepared for the progress and special topical reports.

5418 (COO—2991-28, pp 9-26) **Anaerobic fermentation of livestock and crop residues: pilot plant parametric testing phase. Quarterly progress report (fourth), October—December 1977.** Hashimoto, A.G.; Chen, Y.R. (Meat Animal Research Center, Clay Center, NE). 27 Jan 1978.

In Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.

The operation of the pilot scale fermentor for cattle manures and the biomass recovery systems being investigated are described. In the present quarter the fermentor operated under stress conditions. The events leading to the stress, the fermentor response, and attempts to relieve the stress are summarized. The centrifuge used in the recovery of the biomass malfunctioned. The organic nitrogen content of the biomass is low (18 to 23%). (JSR)

5419 (COO—2991-28, pp 29-42) **Heat treatment of organics for increasing anaerobic biodegradability. Quarterly progress report, September 1, 1977—November 30, 1977.** Healy, J.; Owen, W.; Stuckey, D.; Young, L.Y.; McCarty, P.L. (Stanford Univ., CA). 27 Jan 1978.

In Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.

Results are reported on the effects of alkaline heat treatment on the biodegradability of cellulose, biodegradation of nitrogenous compounds, and biodegradability of aromatic compounds. Methane production can be substantially increased by pretreating at elevated pH and temperature, but extreme pretreatment conditions can convert biodegradable carbohydrates to undegradable substances. Data from long-term studies on the degradability of heat-treated WAS (nitrogenous compounds) show that nitrogenous components of bacterial cells appear to be relatively refractory. Non-oxidative heat treatment can lead to substantial increases in the mesophilic anaerobic biodegradability. In the study of aromatic degradability, examination of the methanogenic biodegradability of ferulic acid, the model lignin derivative, continued. A group of compounds suspected as intermediates in the conversion of ferulic acid to methane was tested. 2-bromoethane sulfonic acid, an inhibitor specific for methane bacteria, was evaluated for its efficacy in specifically blocking methane production. (JSR)

5420 (COO—2991-28, pp 43-58) **Dirt feedlot residue experiments. Quarterly progress report, October 1, 1977—November 30, 1977.** Turk, M. (United Technologies Corp., Windsor Locks, CT). 27 Jan 1978.

In Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.

The loading of aged pen residue which was initiated on August 15, 1977 was continued through the quarter. Initial Total Volatile Acid (TVA) concentrations of 4000 to 5000 mg/l as acetic have decreased to a stable value of approximately 3500 mg/l for the past three months. Continued loading of 0.25 pounds of volatile solids/ft^3/day along with a ten-day retention time has resulted in stable fermentor performance and methane yields averaging approximately 3 ft^3/pound of volatile solids fed. This represents approximately 75% of that obtained from fresh residue. Preliminary results from the evaluation of the centrifuge without the use of flocculant aids indicate suspended solids capture efficiencies ranging up to 85%. However, due to a high level of dissolved dry matter, dry matter capture efficiencies averaged 45%. The test was conducted at various withdrawal rates up to a maximum of 1.25 gpm which was limited by hourly gas production. The captured cake averages 19% crude protein. The capture of organic nitrogen (crude protein) is approximately 50%. The use of flocculants is expected to improve the capture of organic nitrogen (microorganisms) and substantially improve the quality of the captured cake as a refeed product.

5421 (COO—2991-28, pp 59-66) **Pipeline fuel gas from an environmental cattle feedlot. Progress report No. 3, December 1—31, 1977.** Lizdas, D.J. 27 Jan 1978.

In Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.

The progress made in the design of an experimental facility to process by anaerobic digestion 25 tons/day of cattle residues is reported. (JSR)

5422 (COO- `991-28, pp 67-82) **Anaerobic fermentation of agricultural residue potential for improvement and implementation.** Jewell, W.J.; Capener, H.R.; Dell'orto, S.; Fanfoni, K.J.; Hayes, T.D.; Leuschner, A.P.; Miller, T.L.; Sherman, D.F.; Van Soest, P.J.; Wujcik, W.J. 27 Jan 1978.

In Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.

Anaerobic fermentation of organic residues is a unique technology among those presently available that can produce significant quantities of clean renewable energy at a price that may be competitive with those for existing gaseous fuels. This study illustrated that there is great potential for rapid improvement and implementation of this method of processing organic residues. A number of unique developments reported here illustrate two major areas of application that show promise for future development. First, low cost anaerobic fermentors for small scale farming operations may be technically feasible and the operation may be simpler than would be anticipated based on existing literature on sewage sludge fermentation. Presently this phase is being expanded from the pilot-scale laboratory work to large field-scale experimentation at Cornell University. Secondly, high rate anaerobic fermentor designs capable of multi-product recovery have been tested and shown to be feasible.

5423 (COO—2991-28, pp 83-106) **Transcript of presentation by Prof. Marvin Bryant, University of Illinois, given at recent Hastings, Nebraska Meeting.** 27 Jan 1978.

In Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.

Experimental work indicating that anaerobic digestion is a three-stage process, involving three metabolic groups of bacteria, is reviewed. The hypothesized third group, called the hydrogen producing acetogenic bacteria or obligate proton reducing acetogenic bacteria, catabolizes the products from the fermentative bacteria to produce acetate, CO_2, and hydrogen; these are then catabolized by the methanogens. The regulatory aspects of hydrogen production and the change in free energy in some of the reaction occurring are discussed. (JSR)

5424 (COO—2991-28, pp 129-146) **Operation of a 50,000 gallon anaerobic digester at the Monroe State Dairy Farm near Monroe, Washington. Second quarterly technical status report, September 25—December 31, 1977 and milestone plan and management report.** Coppinger, E.; Moodie, P.L.; Brink, G. 27 Jan 1978.

In Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.

Work for the second quarter has continued to focus on the operation, monitoring, repair and shakedown of one of the two 189 m^3 complete mix mesophilic digesters. All major components have been repaired and are operational with the exception of the influent/effluent heat exchanger. Fuel gas production stabilized at a rate of 145 m^3/day with an actual reactor volume of 180 m^3. This gives a ratio of 0.8 m^3 gas/1.0 m^3 reactor volume. Carbon dioxide content of the gas has been approximately 37%. The loading rate has been at approximately 4.0 kg VS/m^3 x d at a feed of 8% total solids with a SRT of 16 days. Currently the solids feed is being increased to 10% at a loading rate of 5.3 kg VS/m^3 x d at a SRT of 15 days. The solids feed and loading rate are being increased in response to a high buffering and low stress in the digester. The pH has been high, 7.4 to 7.6, with TVA's ranging from 450 mg/liter to 1000 mg/l. On December 17, the loading rate was increased. Fuel gas production has risen steadily from 145 m^3/day. There continues to be a discrepancy in the actual amount of volatile solids which are biodegradable in the system. This is primarily caused by the wood shavings used as bedding. Volatil solids destroyed have ranged from a low of 20% to a high of 51%, with a mean of about 35%. Fuel gas production has been 0.55 m^3/kg VS destroyed or 0.18 m^3/kg VS fed. The internal combustion engine has been successfully run on the fuel gas. Daily usage of the engine/generator has been a practice since mid-December. When the engine/generator is operated, no heating is required from the boiler. Electrical conversion efficiencies have been poor, on the order of 10% to 14%. The engine is seldom operated at full load, which probably explains the low efficiencies.

5425 (COO—2991-28, pp 147-154) **Biological conversion of biomass to methane. Quarterly progress report.** Pfeffer, J.T. (Univ. of Illinois, Urbana). 27 Jan 1978.

In Fuel gas production from animal and agricultural residues and biomass. Seventh quarterly coordination meeting, Seattle, Washington, January 9—10, 1978.

A comparison of the efficiencies of complete-mix vs. multistage reactor design showed that a staged reactor system is more efficient than a complete mix system with high conversion of solids to methane. It is more sensitive to stress however. To maximize methane production per unit volume of reactor, a single-stage reactor operating at near the minimum retention time is preferred. The manure fermentation studies have been completed. Final reports are being prepared on both this and the reactor design. (JSR)

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 5524

PROPERTIES

5426 (CONF-771175—) **Proceedings of the international symposium on alcohol fuel technology: methanol and ethanol.** (Department of Energy, Washington, DC (USA). Div. of Transportation Energy Conservation). Jul 1978. 501p. Dep. NTIS, PC A22/MF A01.

From Symposium on alcohol fuel technology; Wolfsburg, F.R. Germany (21 Nov 1977).

The papers presented dealt with the following topics: international situation and economic and political aspects, use of alcohol fuels as automotive fuels, production of methanol and methyl fuels, production of ethanol, methanol application and modeling, alcohol fuel optimization, and environmental considerations. Each paper was prepared for introduction into the EDB data base. (JSR)

5427 (CONF-771175—, pp 1.1.1-1.1.5) **Methanol supply to a Swedish motor fuel market.** Bern, L.; Brandberg, A. (Swedish Methanol Development Co., Stockholm). Jul 1978.

From Symposium on alcohol fuel technology; Wolfsburg, F.R. Germany (21 Nov 1977).

In Proceedings of the international symposium on alcohol fuel technology: methanol and ethanol.

The paper will discuss the reasons for Sweden to consider introduction of synthetic motor fuels. Security in supply, the long-range outlook, and supply also in emergency situations play an important role. Routes to synthetic fuels will be briefly discussed. Alternatives for a production of methanol from various feed-stocks such as wood, peat, shale and refuse will be treated, and availability and cost of the feed-stocks discussed. Wood is traditionally the reserve fuel both for heating and cars in Sweden. Syngas production from gas, oil, and coal is known technology, but new developments are required for wood, peat, and similar feedstocks. Figures on investment costs and production costs from recent studies will be given.

5428 (CONF-771175—, pp 1.2.1-1.2.6) **U. S. alternatives to motor gasoline: methanol or synthetic gasoline.** Boik, B.C. (Amax Inc., Greenwich, CT). Jul 1978.

From Symposium on alcohol fuel technology; Wolfsburg, F.R. Germany (21 Nov 1977).

In Proceedings of the international symposium on alcohol fuel technology: methanol and ethanol.

U.S. gasoline consumption forecasts to the Year 2000 are reviewed with the conclusion that synthetic liquid fuels to replace petroleum gasoline will be needed. Replacement fuels considered are gasoline from synthetic crude from coal or oil shale, and methanol from coal. The author's analyses suggest that the price per mm Btus of methanol at the plant from bituminous coal to $20 per short ton would be $5.32. The price of gasoline would be 6.37 per mm Btus. The cost to the consumer of unmixed methanol and methanol blends with petroleum gasoline would be more than the equivalent costs for synthetic gasoline. Large scale production facilities would require eight years lead time before commencement of production. The magnitude of the required capital investments would discourage U.S. industry from undertaking the production of synthetic fuels without economic incentives from the Government and guarantees based on firm and predictable government energy policies.

5429 (CONF-771175—, pp 1.3.1-1.3.18) **Use of ethanol from biomass as an alternative fuel in Brazil.** Heitland, H.; Czaschke, H.W.; Pinto, N. (Volkswagen do Brasil, Sao Paulo). Jul 1978.

From Symposium on alcohol fuel technology; Wolfsburg, F.R. Germany (21 Nov 1977).

In Proceedings of the international symposium on alcohol fuel technology: methanol and ethanol.

Present results from shown that ethanol is an attractive solution to the fuel problem in the future of Brazil. At this time, ethanol is industrially produced from produce on a broad basis. Sugar can and manioc are the self-regenerating energy sources with optimum utilization and of the inexhaustible solar radiation. However, further improvements are necessary to provide for energy balance of the individual process steps.

5430 (HCP/T4101—03) **Biomass-based alcohol fuels: the near-term potential for use with gasoline.** Park, W.; Price, G.; Salo, D. (Mitre Corp., McLean, VA (USA). METREK Div.). Aug 1978. Contract EG-77-C-01-4101. 84p. Dep. NTIS, PC A05/MF A01.

This report serves as an introduction to the requirements and prospects for a nationwide alcohol-gasoline fuel system based on alcohols derived from biomass resources. Technological and economic factors of the production and use of biomass-based methanol and ethanol fuels are evaluated relative to achieving 5 or 10 percent alcohol-gasoline blends by 1990. It is concluded the maximum attainable is a nationwide 5 percent methanol or ethanol-gasoline system replacing gasoline by 1990. Relative to existing gasoline systems, costs of alcohol-gasoline systems will be substantial.

5431 **High energy fuel slurry.** Outten, E. (to Thiokol Corp.). US Patent 4,090,895. 23 May 1978. Filed date 13 Jan 1966. 6p.

A fuel for rocket motors is provided in the form of a slurry of particulate metal or metalloid particles having a particle size of about 0.1 to 10 microns suspended in an alcohol having from 1 to 3 carbon atoms in the presence of a non-thixotropic amount of high viscosity grade hydroxypropyl cellulose.

PREPARATION

REFER ALSO TO CITATION(S) 5397

5432 Utilization of cyclic rectification principles in the alcohol industry. Mandel'shtein, M.L.; Dorfman, L.B. *Fermentn. Spirt. Prom-st.;* No. 1, 12-15(1977). (In Russian).

An examination is made of the principle and the basic characteristics of controlled cyclic rectification (CCR)—a new modification of the process of separating mixtures. A significant increase is noted in the productivity and efficiency in the cyclic operation of a column. A review is made of works completed both in the USSR and abroad. Several remarks are made with respect to the automation of machines operating with CCR.

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 5036, 5534

5433 Production of synthetic methanol from air and water using controlled thermonuclear reactor power. 2. Capital investments and production costs. Dang, V.D.; Steinberg, M. (Brookhaven Natl Lab, Upton, NY). *Energy Convers.;* **17**: No. 4, 133-140(1977).

Energy requirement and process development of methanol production from air and water using controlled thermonuclear fusion power was discussed in part I of this paper. This second part of the paper presents an economic analysis of the nine alternate processes presented for obtaining carbon dioxide recovery from the atmosphere or the sea for methanol production. It is found that the most economical process of obtaining carbon dioxide is by stripping from sea water. The process of absorption/stripping by dilute potassium carbonate solution is found to be the most economical for the extraction of carbon dioxide from air at atmospheric pressure. The total energy required for methanol synthesis from these sources of carbon dioxide is 3.90 kWh(e)/lb methanol which 90% is used for generation of hydrogen. The process which consumes the greatest amount of energy is the absorption/stripping of air by water at high pressure and amounts to 13.2 kWh(e)/lb methanol. With nuclear fusion power plants of 1000 to 9000 MW(e), it is found that the cost of methanol using the extraction of carbon dioxide from air with dilute potassium carbonate solution is estimated to be in the range between $1.73 and $2.90/MMB.t.u. (energy equivalent--1974 cost) for plant capacities of 21,400 to 193,000 bbl/day methanol. This methanol cost is competitive with gasoline in the range of 19 to 33$cent$/gallon. For the process of stripping of carbon dioxide from sea water, the cost is found to lie in the range of $1.65 to $2.71/MMB.t.u. (energy equivalent) for plant capacities of 21,700 to 195,000 bbl/day methanol which is competitive with gasoline in the range of 18 to 30$cent$/gallon. Projection of methanol demand in the year 2020 is presently based on both its conventional use as chemicals and as a liquid fuel substituting for oil and gas. 17 refs.

5434 Prospects for methanol as a synthetic propellant and fuel. Remmets, T. *Erdoel Kohle, Erdgas, Petrochem.;* **29**: No. 2, 69-73(Feb 1976). (In German).

A commercial survey is to show how much it costs to produce methanol from coal today and if methanol can compete with the conventional carburetor fuel when it is mixed. Methanol in carburetor fuel would meet the demands for engines which do no harm to the environment since the exhaust gas contains less noxious substances and the high octane number of methanol makes it possible to do without adding lead. Disadvantages of using methanol for engines are low energy, poor cold-start-characteristics, and the danger of separation of a liquid phase consisting of methanol/gasoline mixtures which can be caused by the humidity in the air. The use of methyl fuel is only a matter of price. The cost for producing methanol on the basis of natural gas, hard coal, brown coal and mineral oil residues are shown. The author also mentions the problems of natural gas resources which are far away from the consumer and the problems of gas development in mineral oil and the problems of transporting liquified natural gas to the consumer. Deliberations of energy policy favor methanol synthesis on the basis of coal. When there is 15 percent methanol in the carburetor fuel the heating value of the mixture decreases to 92 when compared with pure carburetor fuel. 1.6 million tons of carburetor fuel could be replaced by 3.3 million tons of methanol per year. At the present time, the FRG is producing 2 million tons of methanol per year. The costs of coal gasification must be reduced by improving the techniques and also by using nuclear energy.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 5501, 5505, 6310

5435 (LBL—7847) **Raw materials evaluation and process development studies for conversion of biomass to sugars and ethanol.** Wilke, C.R.; Yang, R.D.; Sciamanna, A.S.; Freitas, R.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 41p. (CONF-7806107—1). Dep. NTIS, PC A03/MF A01.

From 2. symposium on fuels from biomass; Troy, NY, USA (20 Jun 1978).

A range of cellulosic raw materials in the form of agricultural crop residue was analyzed for chemical composition and assessed for potential yields of sugars through chemical pretreatment and enzymatic hydrolysis of these materials. Corn stover was used as a representative raw material for a preliminary process design and economic assessment of the production of sugars and ethanol. With the process as presently developed, 23 gallons of ethanol can be obtained per ton of corn stover at a processing cost of about $1.80 per gallon exclusive of by-product credits. The analysis shows the cost of ethanol to be highly dependent upon (1) the cost of the biomass, (2) the extent of conversion to glucose, (3) enzyme recovery and production cost and (4) potential utilization of xylose. Significant cost reduction appears possible through further research in these directions.

5436 Potential use of yeast biomass productivity in the fermentation of amyloid raw material. Ledenev, V.P.; Bartenev, Yu.S. *Fermentn. Spirt. Prom-st.;* No. 1, 27-29(1977). (In Russian).

An examination is made of alcohol fermentation. A reserve of yeast biomass productivity is formed during the fermentation of amyloid raw material because of the limited rate of feremetation with respect to starch hydrolysis at the secondary fermentation stage. The redistribution of the reserve biomass from the secondary fermentation stage to the head section of the fermenting tank increases the extent of fermentation at this stage and reduces the duration of the entire process. The optimal status of the yeasts for secondary use was shown to be 18 to 20 hours of fermentation. 1 table, 3 illustrations, 2 references.

INORGANIC HYDROGEN COMPOUND FUELS

REFER ALSO TO CITATION(S) 5524, 6183

PREPARATION

REFER ALSO TO CITATION(S) 5036, 5397, 5534

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 5139, 5708

5437 (BNL—24058) **Assessing the employment implications of alternative energy supply, conversion and end use technological configurations: the case of firewood versus fuel oil in New England in 1985.** Groncki, P.J.; Munson, J.S.; Kyle, S.C.; Reckard, M.K. (Brookhaven National Lab., Upton, NY (USA)). Feb 1978. Contract EY-76-C-02-0016. 29p. Dep. NTIS, PC A03/MF A01.

Assessing the forest resources of New England, it is estimated that it would be possible to substitute an additional 0.1 quads of firewood for fuel oil to meet New England's residential and commercial space heating requirements by 1985. On an activity by activity basis, the direct labor requirements for producing this firewood and the direct labor requirements for providing fuel oil in New England are calculated. The study assumes that 40 to 70 percent of the 0.08 quads of residential firewood consumption is purchased, and 90 percent of the 0.02 quads of commercial firewood consumption is purchased (the remainder being cut by the user). This implies that between 10,200 and 16,500 additional jobs could become available if the above technological substitution were to take place. However, only the direct employment impacts have been estimated. The effects on other industries (e.g., wood stove manufacturing) and on the rest of the nation have been ignored.

5438 (CONF-771203—, pp 871-872) **Net energy from municipal solid waste.** Treat, N.L. (Oak Ridge Associated Universities, TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5439 (CONF-7710136—, pp 211-220) **Forest residues as an alternate energy source.** Riley, J.G.; Smith, N. (Univ. of Maine, Orono). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Forest residues, in combination with more-intensified timber-production systems have potential as a substantial source of fuel wood. The extent and availability of this resource is discussed, with particular reference to the energetics and economics of existing and proposed harvesting systems. Utilization of residue wood fuels is considered, and recent developments in small-scale automatic wood-chip-burning heating systems for residential and commercial use are described.

GASEOUS WASTE FUELS

REFER ALSO TO CITATION(S) 5364

HYDRO ENERGY

5440 Evaluation of energy dissipation on sprawling membrane spillways. Kozoreozva, I.M. (Novocherskassk Inst of Reclam Eng, USSr). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 12, 100-102(Dec 1977). (In Russian).

Experimental data are presented on energy dissipation on four types of soft membrane spillways stretched toward the upper pond. An analysis of the work of the resistance forces is given. Based on it, the conclusion is drawn that soft spillways should be singled out as a separate group of spillways with a variable overflow edge.

RESOURCES AND AVAILABILITY

5441 (CONF-771203—, pp 569) **Harvesting kinetic energy from the Florida Current.** Vaughn, P.J. (Ecology Energy Corp., Coral Gables, FL); Leonard, R.J. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

SITE GEOLOGY AND METEOROLOGY

5442 (CONF-771203—, pp 885-886) **Low-head hydroelectric power: a realizable alternative.** Mills, J.I.; Smith, G.L. (EG and G Idaho, Inc., Idaho Falls). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5443 Waterlogging in areas close to banks and protected by dam draining in high-capacity reservoir zones. Kruglov, G.G. (B SSR Polytech Inst). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 12, 94-99(Dec 1977). (In Russian).

The phenomenon of the formation of transit flow and, as a result, of waterlogging of and area protected by a banking dam and by imperfect drainage in the vicinity of the dam is described. Relations are obtained for determining the magnitude of the transit flowrate and the maximum ordinate of the level of groundwater. Taking them into account will make it possible to avoid waterlogging of the area to be protected.

PLANT DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 5686, 6100

5444 (CONF-771203—, pp 581-583) **Extension of the principle of the hydraulic ram as a low head high flow device for use in power development.** Baird, H. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

SOLAR ENERGY

REFER ALSO TO CITATION(S) 4990, 5997, 6076, 6083, 6113, 6233

5445 (CONF-770980—1) **Solar heating as a major source of energy for Australia.** Morse, R.N. (Commonwealth Scientific and Industrial Research Organization, Canberra (Australia)). 1977. 22p. Dep. NTIS (US Sales Only), PC A02/MF A01.

From 10. world energy conference on availability and rational use of energy resources; Istanbul, Turkey (19 Sep 1977).

Solar energy can make its most effective contribution to Australian primary energy in the form of heat for industrial applications. About 50% of all end use energy is required as heat and it is estimated that 40% of this amounting to 1 EJ/a by 2000 could be supplied by solar heat generating systems. This would be 12% of estimated primary energy requirements by that time, and could help reduce the country's increasing dependence on imported oil. Energy self-sufficiency for Australia is possible, based on coal, solar energy and natural gas as primary energy sources. The reason for the present orientation towards residential solar water heaters is that there are many places where electric power for water heating costs between 2 and 4 cents per kWh which makes a solar water heater an attractive proposition. There is also a growing interest in the solar heating of swimming pools, mostly for private homes but also in larger installations for public and institutional pools. Industrial applications, on the other hand, are inhibited by the current low energy prices in Australia, which in some cases are around 0.13 cents/MJ (.47 cents/kWh). Industry, however, uses 40% of Australian primary energy, and represents by far the greatest potential for solar heat generating systems. Demonstration plants are being planned to obtain data on capital and running costs, and at the same time build up professional design and constructional skills in this area. The first demonstration solar industrial process heating system was commissioned in December 1976 and supplies portion of the heat requirements of a soft drink plant in conjunction with the existing oil fired boiler. Integrated solar/oil fired systems of this sort ensure continuous operation of the plant and over a year can result in significant oil savings.

5446 (CONF-771203—, pp 247-248) **National Solar Energy Research Institute: organization, function, and the first six months.** Costello, D.R. (Solar Energy Research Inst., Golden, CO). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5447 (CONF-771203—, pp 253-255) **Solar Sweden.** Johansson, T.B.; Steen, P.; Loennroth, M. (Secretariat for Future Studies, Stockholm). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5448 (CONF-771203—, pp 611-622) **Solar energy: past and present developments.** Pytlinski, J.T. (Kansas State Univ., Manhattan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5449 (CONF-7710136—, pp 16-24) **National Solar Energy Research Institute: function, organization, and the first six months.** Costello, D.R. (Solar Energy Research Inst., Golden, CO). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The role of the Solar Energy Research Institute (SERI) in the national solar program is discussed. A brief history of developments leading to the formation of SERI is included. Functional responsibilities, organization and the current plans for staff and facilities growth are addressed.

5450 (PUB—248) **Solar Energy Program: annual report, 1977.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 45p. Dep. NTIS, PC A03/MF A01.

Progress is summarized briefly on the following topics: analysis of the California solar resource; measurement of circumsolar radiation; controller development and evaluation of control strategies for solar heating and cooling of buildings; LBL Building 90 Solar Demonstration Project; development of solar-driven ammonia-water absorption air conditioners and heat pumps; radiative and passive cooling; Nitinol engine development; chemical storage of thermal energy; passive systems analysis; FEA/HUD/ERDA re-

gional solar energy retrofit of low- and moderate-cost homes; solar information support for DOE (LLL) solar technology transfer program, solar demonstration program: technical review and project monitoring; support activities for DOE Solar Heating and Cooling Research and Development Program; Ocean Thermal Energy Conversion: Environmental Program; appropriate energy technology; functional linking beteen H_2 consumption, N_2 fixation, and photosynthesis in blue-green bacteria; photovoltaic effects of bacteriorhodopsin and studies on its mechanism of action; and environmental assessment of solar energy conversion. (MHR)

5451 (SAND—78-1565) **Sandia energy titles.** Gardner, J.L. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 83p. Dep. NTIS, PC A05/MF A01.

The bibliography of energy-related publications produced by Sandia authors is arranged in broad subject category order. Subjects included are conservation, drilling technology, energy (general), environment and safety, fossil energy, geothermal energy, nuclear energy, and solar energy.

5452 **Japanese project Sunshine for the exploitation of new energy sources.** *Arch. Energiewirtsch.;* **31**: No. 4, 279-281(Apr 1977). (In German).

In order to diminish Japan's dependence on the import of primary energy carriers, the Ministry for Trade and the Chamber of Commerce have elaborated a project called the Sunshine project, running from 1974 until the year 2000. The development of solar energy, the exploitation of geothermal energy sources, coal gasification and liquefaction, and hydrogen production are envisaged.

5453 **Solar energy engineering.** Sayigh, A.A.M. (ed.). New York; Academic Press (1977). 525p. $36.00.

The scope and advantages of solar energy are dealt with. The nature of the sun, the solar radiation spectrum, the estimation of total, direct, and diffuse radiation, and the heat transfer fundamentals for solar energy application are explained. The fundamentals, fabrication, and uses of various water and air heaters are outlined. Optics and concentrating collectors are dealt with, as well as solar furnaces. The various applications of solar energy are discussed, namely, solar pond, solar distillation, photovoltaic conversion of solar energy, solar refrigeration, solar hydrogen production, space applications, and solar measuring equipment. The cost of solar appliances is discussed. (MHR)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 5474, 5507, 5612

5454 (CONF-771042—, pp 125-137) **Generation of a typical meteorological year.** Hall, I.J.; Prairie, R.R. (Sandia Labs., Albuquerque, NM). Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

Technology in solar energy is moving very rapidly. For any given solar energy system an important consideration is its performance. There are many methods available for assessing performance, all of which require meteorological input. Thus, a question that is asked is how well will a given solar energy system perform over a typical year for a given location. Our problem is to develop a typical year. A typical year will not be an average but will be a profile of typical fluctuations that occur in weather over a period of time. There are data available from twenty-six different locations. Each location has hourly data on six different meteorological variables over a number of years. Our intent is to develop a model that represents the joint behavior of the six variables and that can be used for generating a typical year. A set of criteria will be developed based upon the data, and the generated typical year will be checked according to the criteria.

5455 (CONF-771203—, pp 261-262) **Hawaii solar radiation survey summary.** Ekern, P.C.; Yoshihara, T. (Univ. of Hawaii, Honolulu). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5456 (CONF-771203—, pp 271) **Role of solar energy in the solution of Turkey's energy predicament.** Beba, A. (Ege Univ., Bornova-Izmir, Turkey). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5457 (CONF-771203—, pp 643-645) **Calibration standards and field instruments for the precision measurement of insolation.** Reid, M.S.; Berdahl, C.M. (California Inst. of Tech., Pasadena). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5458 (CONF-771203—, pp 649-651) **Probabilistic model of insolation for the Mojave Desert-area.** Hester, O.V.; Reid, M.S. (Jet Propulsion Lab., Pasadena, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5459 (CONF-7710136—, pp 38-45) **Estimating hourly solar radiation for one-axis tracking focusing collectors.** Bingham, C.E. (Solar Energy Research Inst., Golden, CO); Posner, D.M.; Bradley, J.O. 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Performance simulations of focusing parabolic collectors are hampered by a limited amount of useful insolation data. Hourly values of total radiation on a horizontal surface are the most common data available from the National Oceanographic and Atmospheric Administration. A method to convert this total horizontal radiation to direct radiation on the surface of the tracking collector is developed.

5460 (SAND—78-1190C) **Insolation modeling overview.** Boes, E.C. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 5p. (CONF-780639—5). Dep. NTIS, PC A02/MF A01.

From Analysis for solar heating and cooling; San Diego, CA, USA (27 Jun 1978).

A brief summary of a variety of recent and current solar radiation resource assessment activities is presented. Detailed descriptions of several major solar data projects are included which are particularly important for SHAC system simulations. Recommendations are made regarding appropriate solar radiation resource information sources for various SHAC system design and analysis activities. (MHR)

5461 **On the relation between insolation and climatological variables. 3. The relation between normal incidence solar intensity, total insolation, and weather at Fort Hood, Texas.** Rapp, D.; Hoffman, A.A.J. (Univ of Tex at Dallas, Richardson). *Energy Convers.;* **17**: No. 4, 163-172(1977).

An examination of normal incidence solar intensity (NISI) data taken at Fort Hood, Texas, from September 1974 through November 1975 showed repetitive patterns for intensities in clear weather. A correlation is developed which predicts the NISI at any hour of any day of the year in clear weather with a high degree of accuracy. A study of NISI during cloudy weather yielded a correlation for f/sub N/, the fraction of clear day NISI, as a function of cloud cover and visibility. The result is a semi-empirical model which provides a unique prediction of the NISI at all times for all weather conditions. Using this model, it should be possible to convert long-term data on cloud cover and visibility to long-term NISI patterns.

5462 **On the relation between insolation and climatological variables. 4. Construction of a model year of solar intensity and climate.** Rapp, D.; Hoffman, A.A.J. (Univ of Tex at Dallas, Richardson). *Energy Convers.;* **17**: No. 4, 173-181(1977).

Proper design and sizing of a solar energy heating and/or cooling system involves an assessment of the local availability of solar energy and its relationship to local climate. A study is made of availability of solar energy at Fort Hood, Texas for the period 1961-1969. Hourly values of climatological variables were obtained from the National Climatic Center. These are combined with correlations of solar intensity with cloud cover and visibility to obtain hourly estimates of total insolation and normal incidence solar intensity. Monthly totals are calculated for each of the 108 months in 1961-1969, and average monthly solar intensities are obtained. For each month of the year, the month in the 1961-1969 period that most closely approximated the average solar intensities, as well as the average heating and cooling degree-days, is chosen to prepare an average model year. This average has hourly values of solar intensities as well as climatological variables. Hourly models are also prepared for the worst winter and summer months in the period. Finally, a study is made of correlations of solar availability with

degree-days. It is found that there is very little correlation in winter, but in summer sunny days are highly correlated with hot days.

5463 Data monitoring and information availability: a key to solar energy utilization. Kemp, A.J. (International Business Machines Corp., Huntsville, AL). pp 5.29-5.36 of Proceedings of the twelfth space congress. Cape Canaveral, FL; Canaveral Council of Technical Societies (1975).

From 12. space congress; Cocoa Beach, FL, USA (9 Apr 1975).

The energy crisis makes it mandatory to pursue development of alternate energy sources. Solar energy is one of the viable alternate sources. Widespread use of solar energy heating and cooling systems is dependent upon their price competitiveness with other systems in the marketplace. There are indications that the degree of accuracy of existing solar insolation data is such that systems must be oversized by 50 percent. Refinement of the solar insolation data could result in a substantial cost reduction of solar heating and cooling systems making these units more competitive with conventional systems. The Sunfall Monitor system, presently being built by IBM under contract to Marshall Space Flight Center, NASA, is described, which provides this capability. The system monitors and records on tape in computer compatible format the values of the direct and total solar irradiance. Provisions are also incorporated for evaluation of solar cell, collector and absorber material samples. Concepts and discussions for application of the device in relationship to research/development and the solar energy heating and cooling acts are presented.

ECONOMICS

REFER ALSO TO CITATION(S) 5507, 5838

5464 (CONF-771203—, pp 263-265) **General method for the evaluation of possible systems for electricity generation with solar energy.** Pollard, W.G.; Devine, W.D. Jr. (Oak Ridge Associated Universities, TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5465 (CONF-771203—, pp 267-269) **Optimum water and space heating systems; cost effective choices and economic impact of various incentive policies.** Walton, H.L.; Magnas, H.L.; Allen, C. (Federal Energy Administration, Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5466 (CONF-771203—, pp 429-431) **Barriers and incentives to the commercialization of solar heating and cooling of buildings.** Costello, D.R.; Posner, D.M. (Solar Energy Research Inst., Golden, CO). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5467 (CONF-771203—, pp 7-8) **Economics of solar heating and cooling: a cautious view.** Rosenberg, L.C. (National Science Foundation, Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5468 (CONF-771203—, pp 9-11) **Crucial role of financial institutions in solar heating installations.** Roney, J.R.; Blair, J.F. Jr. (Franklin Inst., Philadelphia). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5469 (CONF-7710145—(Summ.)) **Solar technology: moving it into the market place.** Cunningham, D.E.; Johnston, V.; Faver, D.E. (Denver Univ., CO (USA). Center for Public Issues). Nov 1977. 40p. Dep. NTIS, PC A03/MF A01.

From Solar technology) moving it into the market place; Vail, CO, USA (20 Oct 1977).

The comments of the conference participants are summarized grouped by subject headings. The subjects are: solar energy; current technology and future outlook; barriers and incentives to the use of solar technology; the private sector and solar development; and reports on special solar related activities. (MHR)

5470 (DOE/ET—0017) **Survey and analysis of small business and minority business enterprise participation in solar energy procurement activity.** (Department of Energy, Washington, DC (USA). Div. of Solar Technology). Jul 1978. 23p. Dep. NTIS, MF A01.

Portions of document are illegible.

The findings of Small Business and Minority Business Enterprise participation in Solar Energy Programs as a result of procurement actions by the Department of Energy, Division of Solar Technology (DST), and subcontract actions by Solar Technology prime contractors for Fiscal Year 1977 are presented. Information is also presented about awards made to Small Business/Minority Business Enterprise (SM/MBE) by other federal agencies during the same period. The primary findings of this survey indicate that $27.0 million of a total $255.4 million solar energy outlay, for FY 77, was allocated to Small Business in the form of prime contracts. Additionally, $148.4 thousand was allocated to Minority Business Enterprise in the form of prime contracts. Another $13.3 million was subcontracted to Small Business/Minority Business Enterprise (SB/MBE) by prime contractors during this period. This represents a total of $40.3 million solar energy dollars contracted and subcontracted to SB/MBEs or 15.8% of the $255.4 million solar energy outlay during Fiscal Year 1977. The $40.3 million represents an increase of 73% compared to FY 76. Additionally, subsequent sections provide a more detailed description of solar energy and other government agency procurement, the methodology of soliciting, recording and processing survey data used as basis for this report, and appendices containing sample survey forms and other supporting information.

5471 (NP—23379) **Sector-specific output and employment impacts of a solar space and water heating industry.** Petersen, H.C. (Utah State Univ., Logan (USA)). Dec 1977. 88p. National Science Foundation, Washington, DC.

This study identifies those sectors of the economy which would be most affected by increased solar utilization and estimates the magnitude of the changes. The basic methodology involves augmenting an existing Input/Output table to include sectors reflecting solar technology. Data required to augment the matrix were obtained from questionnaires returned by existing firms involved in collector manufacture or solar space and water heating system sales. The augmented I/O matrix was inverted to generate a direct and indirect requirements matrix. The elements of this matrix estimate the changes in total sector output resulting from changes in final demand of other sectors. Estimates of final demand for solar heating systems by 1985 and projections of energy savings associated with solar installations to that time were obtained from existing studies. Using the computed direct and indirect requirements matrix and the assumed changes in the composition of final demand, estimates of changes in sales and employment were derived for 131 sectors of the U.S. economy. It was determined that the sectors most affected by solar development will be those involved in electricity generation and the mining, refining, and fabrication of metals, especially copper. The proportionate changes in industry sales and employment are not expected to be very great. Only copper rolling and drawing is changed by as much as 2 percent. This finding suggests that the government can proceed with programs designed to accelerate solar space and water heating usage without fear of adversely affecting any sector of the economy or creating excessive demands for natural resources or productive capacity.

5472 (PNL—2711) **Methodology for identifying materials constraints to implementation of solar energy technologies.** Litchfield, J.W.; Watts, R.L.; Gurwell, W.E.; Hartley, J.N.; Bloomster, C.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1978. Contract EY-76-C-06-1830. 91p. Dep. NTIS, PC A05/MF A01.

A materials assessment methodology for identifying specific critical material requirements that could hinder the implementation of solar energy has been developed and demonstrated. The methodology involves an initial screening process, followed by a more detailed materials assessment. The detailed assessment considers such materials concerns and constraints as: process and production constraints, reserve and resource limitations, lack of alternative supply sources, geopolitical problems, environmental and energy concerns, time constraints, and economic constraints. Data for 55 bulk and 53 raw materials are currently available on the data base. These materials are required in the example photovoltaic systems. One photovoltaic system and thirteen photovoltaic cells, ten solar heating and cooling systems, and two agricultural and industrial process heat systems have been characterized to define their engineering and bulk material requirements.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 5466, 5587

5473 (CONF-7710136—, pp 197-205) **Barriers and incentives to the commercialization of solar heating and cooling of buildings.** Costello, D.R.; Posner, D.M. (Solar Energy Research Inst., Golden, CO). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Potential barriers to the widespread use of solar heating and cooling systems in residential and commercial buildings are reviewed. Although solar systems have been technologically proven and are used to a limited extent today, economic, institutional, and legal barriers may slow future commercialization. Consideration of incentives that might reduce these barriers raises the question of how to evaluate alternative policy-question options.

5474 (DOE/ET—0020/1) **Environmental and resource assessment program: program summary.** (Department of Energy, Washington, DC (USA). Div. of Solar Technology). Jan 1978. 96p. Dep. NTIS, PC A05/MF A01.

Research projects are conducted in the following areas: environmental assessment, technology assessment, resource assessment, and material assessment. Project summaries for 1977 are included. (MHR)

5475 (NP—23206) **Forum on solar access. Proceedings of a forum on solar access held by the New York State Legislative Commission on Energy Systems, New York, NY, July 28, 1977.** (National Solar Heating and Cooling Information Center, Rockville, MD (USA)). 1977. 80p. National Solar Heating and Cooling Information Center, Rockville, MD.

A transcription of hearings held by the New York State Legislative Commission on Energy Systems on the problem of solar access on July 28, 1977, is presented. The Forum on Solar Access was held to analyze various approaches to protecting access to sunlight. Testimony is included of representatives of HUD and the National Solar Heating and Cooling Information Center and various attorneys, professors, and architects from the private sector. (WHK)

SOLAR ENERGY CONVERSION

5476 **Converting solar energy into electricity: a major breakthrough. Hearing before a Subcommittee of the Committee on Government Operations, House of Representatives, Ninety-Fourth Congress, Second Session, June 11, 1976.** Washington, DC; Committee on Government Operations (1976). 38p. GPO $1.00.

At this hearing, Joseph C. Yater, Lincoln, Massachusetts, presented for review his invention to convert heat or solar energy directly into a useful form of electric energy. He described the technical features of the device after briefly discussing the general nature of fluctuation voltage, as this is basic to the invention. The device of the invention first converts the thermal energy to electric voltage fluctuations which in turn are relayed across a thermal barrier to small rectifying circuits to produce with high efficiency useful direct current output power. Mr. Yater then listed the applications for this invention--Earth solar power, steam power plants, topping and tailing, space solar power stations, and heat pumps or refrigerator. All applications result in large energy savings. The circuit may be used in a refrigerator made to reduce the input noise voltage and increase the sensitivity of radio receivers and amplifiers. The publication contains statements by Albert L. Hedrich, National Bureau of Standards; Dr. Robert L. Hirsch, ERDA; and George P. Lewett, National Bureau of Standards. Additional information submitted for the record are also included. (MCW)

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 5513, 6221, 6296

5477 (CONF-771203—, pp 787-789) **Photovoltaic power generation by use of compound parabolic concentrators.** Gorski, A.J.; Cole, R.L.; Graven, R.M.; McIntire, W.R.; Schertz, W.W.; Winston, R.; Zwerdling, S. (Argonne National Lab., IL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5478 (CONF-771203—, pp 791-792) **Perspectives on solar electric power for small homes.** White, J.R.; Marshall, J.F.; Offenhauer, R.D. (Mobil Research and Development Corp., Princeton, NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5479 (CONF-771203—, pp 793-795) **Solar thermal photovoltaic electric power generator.** Horne, W.E. (ENERAD Corp., Bellevue, WA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5480 (CONF-771203—, pp 797-798) **Photovoltaic conversion: can its efficiency be improved through the application of color response data.** Ertel, D. (Univ. of Miami, Coral Gables, FL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5481 (DOE/JPL/954559—6) **Solar silicon via the Dow Corning process. Quarterly report No. 8.** Hunt, L.P.; Dosaj, V.D. (Dow Corning Corp., Hemlock, MI (USA). Solid-State Research and Development Lab.). Jul 1978. Contract NAS-7-100-954559. 51p. Dep. NTIS, PC A04/MF A01.

Purity goals were established for raw materials and silicon at various stages of the process train based upon current knowledge of the purity required for solar-grade silicon. Raw materials have been identified that meet these goals. Activated carbon, carbon black, charcoal (wood), lignite, petroleum coke, and sugar charcoal were investigated as potential reductants for quartz. Various sources of activated carbon and carbon black were shown to have sufficient purity as purchased from vendors. Lignite and petroleum coke were eliminated from further consideration due to lack of purity and/or reactivity. Charcoal and sugar charcoal are still under investigation but on a comparatively lower level of effort at this stage. Activated carbon and carbon black were pelletized and found to be excellent reductants in the DAR. Activated carbon pellets provided silicon production rates of about 2 kg/h at the lowest energy consumption yet. Experimental tests typically ranged from 24-48 hours in order to evaluate the reactivity of the reductants. Further work is required to optimize reaction conditions and to demonstrate silicon purity. Silicon produced in the DAR is being purified in the final process step of unidirectional solidification using small-scale laboratory equipment that was developed for pulling Czochralski crystals for the semiconductor industry. The SoG-Si from this process will be evaluated by Dow Corning and by JPL. However, it is strongly pointed out that current technology in this unidirectional solidification step does not allow the projected cost goal of $7.40/kg Si to be reached. Large-scale unidirectional solidification technology must be developed in parallel with the production of silicon in the DAR in order for the Dow Corning Process to be able to meet the time goals of the LSA Project.

5482 (DOE/JPL/954853—2) **Array automated assembly: Phase 2. Quarterly report for period ending March 31, 1978.** Taylor, W.E.; Kimberly, W.; Mardesich, N.; Pepe, A. (Spectrolab, Inc., Sylmar, CA (USA)). May 1978. Contract NAS-7-100-954853. 68p. Dep. NTIS, PC A04/MF A01.

Surface topography of texturized solar cells was investigated. No significant differences were found between high output and low output cells with a common texturizing treatment. Differences were found between high output and low output cells with a common texturizing treatment. Differences were found associated with variation in the damage removal etch prior to texturizing. Titania precipitated glasses were found to have suitable properties for use as a diffusion masking dielectric. Preliminary attempts to make solar cells were not successful. Emulsitone N-250 phosphorous diffusion source was identified to be suitable for solar cell fabrication, and a diffusion procedure was identified. A number of commercially available fritted silver pastes have been identified as giving promising results. Methods of paste modification by additions of donor source additions and frit content adjustments were found to be effective in proving the performance of some commercial pastes. Printed silver solder pads on aluminum back contacts were found to be subject to corrosive failure in humidity testing. Tin pads were found to be free of this deficiency. A module design comprised of an array of 10 by 20 square cells in an area approximately 2 feet by 4 feet was resolved. Projected module efficiency is 12.5%. "LO IRON" sheet glass furnished by ASG Industries was selected for the superstrate as

being the most cost effective for projected module costs below $1.09 per watt.

5483 (DOE/JPL/954862—2) **Development of a model and computer code to describe solar grade silicon production processes. Second quarterly report, January 1—March 31, 1978.** Gould, R.K.; Thorpe, R.D. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). May 1978. Contract NAS-7-100-954862. 14p. (AeroChem-TN—190). Dep. NTIS, PC A02/MF A01.

This program aims at developing a mathematical model, and a computer code based on this model, which will allow prediction of the product distribution in chemical reactors in which gaseous silicon compounds are converted to condensed-phase silicon. The reactors to be modeled are flow reactors in which silane or one of the halogenated silanes is thermally decomposed or reacted with an alkali metal, H_2 or H atoms. Because the product of interest is particulate silicon, processes which must be modeled, in addition to mixing and reaction of gas-phase reactants, include the nucleation and growth of condensed Si via coagulation, condensation, and heterogeneous reaction. During this report period the free shear layer turbulent mixing code with (i) gas-phase chemical kinetics routines and (ii) particle routines that compute particle/gas momentum and energy exchange (particle slip and thermal lag) have been debugged and tested. The routine that treats Si nucleation and thus provides source terms for the particle growth (coagulation and condensation) has been coded and is being debugged. Particle coagulation routines are also being inserted into the main code. The condensation model to be included in the code is nearly complete and coding of this routine will be started shortly.

5484 (DOE/JPL/954873—2) **Phase 2 of the Array Automated Assembly Task for the Low Cost Silicon Solar Array Project. Second quarterly report, January 1—March 31, 1978.** Szedon, J.R.; Campbell, R.B.; Ghoshtagore, R.N.; O'Keeffe, T.W.; Scala, L.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 23 May 1978. Contract NAS-7-100-954873. 48p. Dep. NTIS, PC A03/MF A01.

Development effort has been applied in these areas during the second quarter: effects of back surface field (BSF) region diffusions, application of anti-reflection coatings and photoresist layers to web silicon cells by dipping and cell separation by laser scribing. In addition, consideration has been given to selecting appropriate adhesives for encapsulation of completed modules. A review has been made of the properties of several organic materials as candidates for the adhesives in preparing modules with cell arrays encapsulated between sheets of glass. Room temperature curing materials have been chosen to eliminate the need for a costly and time consuming curing step.

5485 (TID—28692) **Investigation of thin film solar cells based on Cu_2S and certain ternary compounds. Final report, July 1, 1973—December 31, 1976.** Loferski, J.J.; Cometta, C. (Brown Univ., Providence, RI (USA). Div. of Engineering). Sep 1977. 62p. Dep. NTIS, MF A01.

Portions of document are illegible.

Copper sulfides, especially chalcocite (Cu/sub x/S with 2.000 < or = x < or = 1.995) and $CuInS_2$ have been studied as semiconductors for photovoltaic solar cell applications. Thin films (0.1 to 0.5μ) of copper sulfides have been produced by sulfurizing thinner films of evaporated copper and by chemical substitution of Cu ions for Cd ions in CdS single crystals and thin films. They have been characterized by x-ray diffraction, cathodoluminescence, optical transmission and reflectance, conductivity, Auger spectroscopy and scanning electron microscope analysis. Only chalocite and a tetragonal phase of composition Cu/sub x/S with x approximately 1.94 luminesce. Thin films of djurleite or diginite could not be produced by sulfurization. Solar cells involving heterojunctions between chalcocite and single crystals of n-CdS and n-Si have been fabricated and characterized. In the case of CdS substrate cells, the highest efficiencies (approximately 4%) were encountered when the Cu/sub x/S layer was produced by the Philips process; the next best, when the Cu/sub x/S layer was produced by the Clevite process (eta approximately 3%) and the poorest when the Cu/sub x/S layer was produced by sulfurizing a previously deposited thin film of Cu (eta approximately 2%) even though cathodoluminescence (CL) shows that the chalcocite produced by sulfurization is pure, whereas the chalcocites derived from CdS have a CL spectrum distinctly different from what is known to be pure chalcocite. The studies also show that the CL spectrum of the chalcocite derived from CdS changes with time whereas the sulfurized chalcocite is stable with time. A CL study of the effects of post fabrication treatments on chalcocite is also reported. Heterojunctions formed between p-chalcocite and n-Si have efficiencies up to about 4% and potential efficiencies up to 10%. The work on $CuInS_2$ was concentrated on preparation of single crystals and their characterization by x-ray analysis and CL.

5486 **New TiO/sub x/-MIS and SiO_2-MIS silicon solar cells.** Van Halen, P.; Mertens, R.P.; Van Overstraeten, R.J.; Thomas, R.E.; Van Meerbergen, J. (Kathol Univ Leuven, Belg). *IEEE Trans. Electron Devices;* **ED-25**: No. 5, 507-511(May 1978).

Two new types of solar cells are described in which either a TiO/sub x/ or a SiO_2 layer is deposited onto p silicon; contacts are obtained by means of a MIS tunnel diode grid. It is shown that the TiO/sub x/-MIS cells can be realized by single-mask completely low-temperature processing by employing spin-on of titanium-oxide antireflective coating. Conversion efficiencies of 8 percent at AM1 have been achieved with these cells; they perform even more efficiently at higher illumination levels. With the SiO_2-MIS cells efficiencies of 12 percent have been reached, at the expense of a slightly more complicated process. A detailed comparison betwen the two cells is given.

5487 **Computer anAlysis of Ga/sub 1-x/al/sub x/As-GaAs solar cells with multilayered window structure.** Usami, A.; Hamamoto, Y.; Sonobe, M. (Nagoya Inst of Technol, Gokiso-Cho, Jpn). *IEEE Trans. Electron Devices;* **ED-25**: No. 5, 546-547(May 1978).

Numerical calculations have been made of the spectral response and conversion efficiency of Ga/sub 1-x/Al/sub x/As-GaAs solar cells with multilayered window structures. Maximum conversion efficiencies of about 20 percent are predicted, equaling those achieved with graded band-gap solar cells, for the case of three-layered window structures.

5488 **Sun on a semiconductor.** *EPRI J.;* **3**: No. 2, 20-25(Mar 1978).

The Electric Power Research Institute (EPRI) supports research on photovoltaic electric systems and believes that new technological developments to reduce manufacturing costs can make photovoltaic conversion economically feasible. Direct conversion to electricity, simple maintenance, the ability to use diffuse radiation, and its modular nature are the qualities that make a photovoltaic electric system attractive. The expense of growing high-purity silicon single crystals and the wastefulness of the processing technique must be corrected to make the costs competitive. DOE and EPRI programs differ in that government efforts are aimed at perfecting the conventional single-crystal approach, while EPRI's assessments set top priority on new materials and/or concepts. Among EPRI's programs are thermophotovoltaic conversion, thin-film research, and market research into appropriate applications and scale.

5489 **Development of a large double-roll-out solar array in the multi-kW range.** Bebermeier, H.; Hoffmann, U. (AEG-Telefunken, Wedel/Holstein, Ger). *Z. Flugwiss. Weltraumforsch.;* **2**: No. 2, 121-130(1978). (In German).

A description of the solar generator design is presented. The set up and function of the different solar generator components and subsystems is illustrated. Results of analyses and of design verification tests carried out are given. The planned design qualification test program for the double-roll-out system is described. The future operational application of this solar generator concept includes high-power satellites, free flyers and space stations in the 1980's.

5490 **Crystal-violet/tin-oxide solar cell.** Williams, E.W. (Imp Chem Ind Ltd, Corp Lab, Runcorn, Cheshire, Engl). *IEE J. Solid-State Electron Devices;* **1**: No. 6, 185-192(Nov 1977).

The crystal-violet/tin-oxide solar cell which has been reported briefly in a recent patent was tested for u.v. stability under a variety of chemical conditions, and, in every case, was found to be unstable. Degradation effects produced by chemical reactions are strongly indicated by absorption and action spectra as the pH of the cell was varied. The p-n junction model is rejected for this type of crystal-violet/tin-oxide heterojunction cell. The potential of organic solar cells based on a dye-oxide semiconductor junction for cheap, lightweight and large-area devices is discussed, and some of the possible materials are reviewed. 20 refs.

5491 **Computer-aided design of multilayer-structure Ga/sub 1-x/Al/sub x/As-GaAs solar cells.** Usami, A.; Hamamoto, Y. (Nagoya Inst of Technol, Gokiso-Cho, Jpn). *IEE J. Solid-State Electron Devices;* **1**: No. 6, 182-184(Nov 1977).

The spectral response, the voltage and current that give maximum power, the the conversion efficiency have all been calculated for Ga/sub 1-x/Al/sub x/As/p-GaAs/n-GaAs solar cells that have multilayer GaAlAs windows on their surfaces. In the numerical analysis, photo-generated carrier collection in the window layers was considered. The spectral response in the short-wavelength region could be improved if either the Al composition factor x of the window layer was made larger or the window was made thinner. The lifetime of the carriers in the p-GaAs layer is especially important for improving the spectral response and the conversion efficiency. The increases of donor concentration in the n-GaAs bulk region and of acceptor concentration in the p-GaAs layer cause the current and voltage to increase. Thus the multilayer structures can make efficient use of the short-wavelength region of the spectrum and be

easier to produce than a continuously graded structure. Conversion efficiencies can be approximately 20% in AMO.

5492 Photovoltaic effects in II-VI heterojunctions. Bube, R.H. (Stanford Univ, Calif). *SPIE Semin. Proc.;* **114**: 7-13(1977).

Photovoltaic effects were investigated in II-VI heterojunctions prepared by close-space vapor transport, vacuum evaporation, spray pyrolysis and sputtering. Solar efficiencies of about 8% have been measured for the following systems: (a) n-CdS film deposited on single crystal p-CdTe by vacuum evaporation, (b) n-ZnCdS film deposited on single crystal p-CdTe by sputtering in an inert atmosphere. Open-circuit voltages greater than 0.8 V are measured in heterojunctions of type (b) and (c), as well as in CdTe p-n homojunctions produced by ion implantation.

5493 Maximization of operating efficiency of solar cells. Divan, D.M.; Hasan, M.M. (Univ of Calgary, Alberta). *Energy Convers.;* **17**: No. 4, 183-188(1977).

Two optimal control systems were devised for maximizing the operating efficiency of a solar cell working into any load for arbitrary conditions of illumination. Considering the variation of solar intensity on an average day, the proposed techniques result in an efficiency, which is at least 17% greater than the solar cell's average operating efficiency without control.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 5412, 5414, 5415, 5416, 5417, 5418, 5419, 5420, 5421, 5422, 5423, 5424, 5425, 5429, 5435, 5437, 5439, 5536, 6077, 6112

5494 (CONF-771203—, pp 639-641) **BIOSOL Process.** Pelofsky, A.H. (Science Applications, Inc., E. Brunswick, NJ); Manley, S. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5495 (CONF-7710163—2) **Application of SGFM technology to other feedstocks: a review.** Huffman, W.J.; Beck, S.R.; Bartsch, R.A.; Landeene, B.C.; Lin, C.S.; Wong, H. (Texas Tech Univ., Lubbock (USA)). 26 Oct 1977. Contract EY-76-S-04-3779. 37p. Dep. NTIS, PC A03/MF A01.

From Contractors meeting; Ballston Spa, NY, USA (25 Oct 1977).

Synthesis gas technology developed for the thermochemical processing of cattle feedlot manure to produce an ammonia synthesis gas is reviewed. Basic data on heat balance, mass balance, product, and internal reactor gas composition were developed and used for an economic analysis. A data base is being established to demonstrate that this technology can be applied to other feedstocks, including wood and wood residue for the production of 300 to 500 Btu gas. (JGB)

5496 (COO—2948-2) **Cultivation of macroscopic marine algae and freshwater aquatic weeds. Progress report, May 1—December 31, 1976.** Ryther, J.H. (Woods Hole Oceanographic Institution, MA (USA)). Jan 1977. Contract EY-76-S-02-2948. 346p. Dep. NTIS, PC A15/MF A01.

Research was divided between basic physiological studies of the growth and nutrient-uptake kinetics of macroscopic marine algae and the more applied problems involved in the selection of species and the development of inexpensive, non-energy intensive culture methods for growing seaweeds and freshwater plants as a biomass source for conversion to energy. Best growth of the seaweeds occurs at low (0.1 to 1.0 μmolar) concentration of major nutrients, with ammonia as a nitrogen source, with rapid exchange of the culture medium (residence time of 0.05 days or less). Of 43 species of seaweeds evaluated, representatives of the large red alga genus Gracilaria appear most promising with potential yields, in a highly intensive culture system under optimal conditions, of some 129 metric dry tons per hectare per year (about half of which is organic). Non-intensive culture methods have yielded one-third to one-half that figure. Unexplained periodicity of growth and overgrowth by epiphytes remain the most critical constraint to large-scale seaweed culture. Freshwater weed species in culture include water hyacinth (Eichhornia crassipes), duckweed (Lemna minor), and Hydrilla vertecillata, with yields to date averaging 15, 4, and 8 g dry wt/m^2/day, respectively. However, these plants have not yet been grown through the winter, so average annual yields are expected to be lower. In contrast to the seaweeds, the freshwater plants grow well at high nutrient concentrations and slow culture volume exchange rates (residence time ca. 20 days or more). Experiments were initiated on the recycling of digester residues from the fermentation of the freshwater and marine plants as a possible nutrient source for growth of the same species.

5497 (COO—2952-15) **Dirt feedlot residue experiments. Quarterly progress report, July 1—September 30, 1977.** Turk, M. (United Technologies Corp., Windsor Locks, CT (USA). Hamilton Standard Div.). Oct 1977. Contract EY-76-C-02-2952. 77p. Dep. NTIS, PC A05/MF A01.

Progress is reported in the continued evaluation of baseline performance of the mobile fermentation system utilizing fresh beef steer residue at 0.25 lb. volatile solids/ft^3/day with a ten day residence time and an operating temperature of 57°C. Evaluation of the comparative yield from typical aged feedlot pen residue at the same parametric conditions previously used for the baseline study was initiated. Total daily gas production, as well as specific methane yield, indicated a sudden decrease. This decrease, however, stabilized relatively quickly indicating that the material, while having a lower gaseous yield, was not grossly toxic. The 10 day running average of specific methane yield, which acts as a smoothing function for the somewhat more erratic daily yields, indicates a yield of 2.5 ft^3 CH_4/pound volatile solids. This represents 60% of that obtained from the fresh residue and is most encouraging. During this period of time the concentration of Total Volatile Acid was allowed to rise. That is, no attempts at control (e.g., iron chloride) were made in order to learn what equilibrium value would result. By the end of the reporting period, the TVA concentration was approximately 4000 to 5000 mg/l. (JGB)

5498 (COO—2952-17) **Monfort dirt lot experiments. Status report.** (Hamilton Standard, Windsor Locks, CT (USA)). 31 Mar 1978. Contract EY-76-C-02-2952. 33p. Dep. NTIS, PC A02/MF A01.

A mobile processing unit is being used to investigate the feasibility of producing fuel gas and an energy-intensive refeed product from dirt feedlot residues by anaerobic fermentation. Results to date have shown that: a stable fermentation can be achieved utilizing aged feedlot pen residue if a sufficient adaptation period is provided. Methane yields of 2.75 ft^3/pound volatile solids fed can be attained at a loading rate of 0.25 pounds volatile solids/ft^3, 10 day retention time and thermophilic temperature of 57°C. The fermentor liquid effluent is acceptable to cattle as a feed ingredient and was used to provide one-half the daily supplemental protein for twenty steers. Residual pharmaceuticals and low levels of heavy metals as well as various anions and cations may possibly impose some additional stress upon the system but do not present a significant detriment to successful operation. Feedlot residue is highly variable in both dry matter and inert content with typical particle size in the micron range.

5499 (COO—2952-18) **Dirt feedlot residue experiments. Quarterly progress report, December 1977—March 1978.** Turk, M. (United Technologies Corp., Windsor Locks, CT (USA). Hamilton Standard Div.). Apr 1978. Contract EY-76-C-02-2952. 86p. Dep. NTIS, MF A01.

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Performance of the mobile fermentation system is reported. It made use of aged pen residue at the nominal loading rate of 0.25 lbs. volatile solids/$ft.^3$/day with a 10-day retention time and a fermentation temperature of 57°C. Results of an experimental cattle feeding trial utilizing the protein in the fermentor liquid effluent as a replacement for standard protein supplements were encouraging. The evaluation of the capture efficiency of the system centrifuge both with and without a chemical flocculant was completed. An experimental cattle feeding trial utilizing the protein fermentation product (PFP) harvested by the centrifuge as replacement for the standard protein supplementwas initiated. The characterization of the cattle residues found in various cattle pens, feedlots, and locations was continued. An investigation was initiated into methods of separating the organic content of the feedlot residue from the sand and grit content. (JGB)

5500 (HCP/T2557—01) **Eucalyptus Energy Farm: feasibility study and demonstration. Phase 1: site and species selection.** Mariani, E.O.; Wood, W.A.; Kouchoukos, P.C.; Minton, M.B. (Marelco, Inc., Alexandria, VA (USA)). Jun 1978. Contract EG-77-C-01-2557. 304p. Dep. NTIS, MF A01.

Portions of document are illegible.

The results of investigations to determine the feasibility for establishing "Eucalyptus Energy Farms" as a potential source of biomass derived energy are presented. Included in this report are: the results of an extensive literature search and numerous field interviews (both domestically and internationally) to identify those Eucalyptus species most suitable for use within the United States; a description of the site selection criteria, site selection process, and identification of potential sites for use in testing the Eucalyptus Energy Farm concept; a description of the Eucalyptus species selection criteria, species selection process, and an identification of the specific species recommended for testing at specific sites; preliminary engineering designs for each of the proposed plantation sites; and environmental impact considerations related to Eucalyptus growing. It is concluded that although the Eucalyptus are extremely temperature sensitive and the geographic areas which appear suit-

able for their planting (within the United States) are principally confined to western and central California and the warmest regions of the southeastern United States, each of the areas contain large amounts of marginal land which could be converted into Eucalyptus based biomass plantations. Suitable sites, which are representative of the larger marginal land areas, are immediately available for use in establishing Eucalyptus screening test sites. Furthermore, there are not significant environmental conditions which would preclude the establishment of these initial test sites. It is therefore recommended that efforts be initiated to obtain selected provenances of Eucalyptus seeds (of the designated species) for further field testing and data collection within the United States, and that actual site selection be initiated.

5501 (HCP/T4101—04) **Biomass fuel systems: directory of sources and potential users.** Henry, J.F.; Salo, D.J.; Schauffler, M.S.; Smith, B.T. (Mitre Corp., McLean, VA (USA). METREK Div.). Aug 1978. Contract EG-77-C-01-4101. 103p. Dep. NTIS, PC A06/MF A01.

Sources and potential users of technical information on biomass fuel systems are identified. Organizations and individual contacts are listed in various production and conversion categories.

5502 (HCP/T4388—02) **Acetic acid production from marine algae. Progress report No. 2, September 30—December 31, 1977.** (Dynatech Corp., Cambridge, MA (USA)). 1977. Contract EG-77-C-02-4388. 36p. Dep. NTIS, PC A03/MF A01.

Preliminary results on the production of acetic acid from marine algae by anaerobic fermentation indicate that the rate is quite fast. First order rate constants of 0.77 day^{-1} were observed. This rate constant gives a half-life of less than one day. In other words, with a properly designed product removal system a five day retention time would yield 98% of theoretical conversion. Determination of the theoretical conversion of marine algae to acetic acid is the subject of much experimentation. The production of one acetic acid molecule (or equivalent in higher organic acids) for each three carbon atoms in the substrate has been achieved; but it is possible that with a mixed culture more than one acetic acid molecule may be produced for each three carbons in the substrate. Work is continuing to improve the yield of acetic acid from marine algae. Marine algae have been found to be rather low in carbon, but the carbon appears to be readily available for fermentation. It, therefore, lends itself to the production of higher value chemicals in relatively expensive equipment, where the rapid conversion rate is particularly cost effective. Fixed packed bed fermenters appear to be desirable for the production of liquid products which are inhibitory to the fermentation from coarse substrates. The inhibitory products may be removed from the fermentation by extraction during recirculation. This technique lends itself to either conventional processing or low capital processing of substrates which require long retention times.

5503 (ORO—5422-1) **Production of sugarcane and tropical grasses as a renewable energy source. First quarterly report, June 1—August 31, 1977.** Alexander, A.G. (Center for Energy and Environment Research, Mayaguez (Puerto Rico)). 1977. Contract EG-77-G-05-5422. 24p. Dep. NTIS, PC A02/MF A01.

Research was initiated on the intensive production of sugarcane and other tropical grasses as solar-dried forages. Greenhouse experiments designed to screen candidate clones and to evaluate growth curves were the first to get underway. Chemical growth control tests were also initiated. Plant materials at this stage consist of commercial sugarcane hybrids, progeny from the AES-UPR cane breeding program, Saccharum clones from the species officinarum, spontaneum, sinense, and robustum, Erianthus clones, a commercial tropical forage grass, napier grass, and forms of S. spontaneum plus Arundo donax growing wild in Puerto Rico. Initial stages of cane breeding and progeny selection for the high tonnage attribute were begun during August. Foliar tissue analyses for N, P, K, S, and Si were started together-with assays for acid invertase and other components of expanding stem tissue. The first field experiment was initiated during July at the semi-arid Lajas Substation. Four clones (three sugarcane hybrids plus napier grass var. Merker) are being evaluated incident to row spacing and harvest frequency in field-plots.

5504 (TID—28415) **Bench scale research in thermochemical conversion of biomass to liquids in support of the Albany, Oregon, Experimental Facility.** Elliott, D.C.; Walkup, P.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 26 Oct 1977. Contract EY-76-C-06-1830. 17p. Dep. NTIS, PC A02/MF A01.

Research is reported in the effort to optimize process parameters in the conversion of organic solid materials to useful liquid fuels. The process entails the liquefaction of solid materials (wood, meswprint, refuse, animal manure) by heating to about 350°C under carbon monoxide and steam pressure, in the presence of sodium carbonate, water, and recycle oil. Initial tasks were directed toward: evaluation of process operation at reduced system pressure; evaluation of process operation at reduced carbon monoxide overpressures; and study of the effect of recycling the oil and aqueous phases. The role of the sodium carbonate catalyst and the fate of the CO consumed during the course of the reaction were studied by the use of radiotracer techniques. A quick heatup/cooldown autoclave was used to investigate process parameters. (JGB)

5505 **Chemistry, population, resources.** Calvin, M. (Univ. of California, Berkeley). *Interdiscip. Sci. Rev.;* **3**: No. 3, 233-243(Sep 1978).

Chemistry plays a dominant role in the development of modern human societies over the entire globe. Improving the health and nutrition of people has led to a rapid growth in population, especially among the developing nations. Increase in energy supplies has not matched population growth and, arguably, our total stock of accumulated energy capital is diminishing rapidly. The use of coal or nuclear fuels, instead of oil, would present their own set of problems. There is, however, the possibility of using sunshine directly, and thus living on our annual income of energy from the Sun. It would be possible, argues the following article, to grow hydrocarbon-producing plants in arid or semi-arid regions of the Earth where they would not compete with food production, and produce hydrocarbons at the order of $20.00 a barrel compared with the current crude oil price of $14.00 a barrel.

5506 **Solar energy conversion through biology--could it be practical energy source.** Hall, D.O. (Univ of London, King's Coll, Engl). *Fuel;* **57**: No. 6, 322-333(Jun 1978).

An analysis is made of the mechanisms of photosynthesis for possible applications of such conversion of energy. Description is given of several ways in which solar/biological systems could be realized to varying degrees over the short and long term. Some, such as the utilization of biological and agricultural wastes, energy farming, and use of leaf protein could be put into practice immediately. Photobiological systems can be tailored to suit an individual country taking into consideration total energy availability, local food and fiber production, ecological aspects, climate and land use.

5507 **Harvesting the Sun: a biological approach.** Shen-Miller, J. (Argonne National Lab., IL). *Perspect. Biol. Med.;* **21**: No. 1, 77-88(Aut 1977).

The author discusses the need for developing the renewable energy resources of the sun. The discussion is limited to the use of cellulose, the most abundant organic compound on earth, as a source of fuel. The contribution of individual sources of cellulosic waste could amount to as much as 8 percent of the total estimated U.S. energy demand for the year 2000 and a monetary value of 48.3 billion dollars. Included in the discussion are: various cellulosic sources, gross fuel production from each source, some of the fuel production processes and problems and the necessary areas of biological research.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 5380, 5381, 5390

5508 (COO—4178-1) **Photochemical energy storage: studies of inorganic photoassistance agents. Progress report, April 1, 1977—March 31, 1978.** Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). Dec 1977. Contract EY-76-S-02-4178. 16p. Dep. NTIS, PC A02/MF A01.

Research accomplishments include (i) demonstration of the photoassisted oxidation of $Fe(eta^5\text{-}C_5H_5)_2$ to $Fe(eta^5\text{-}C_5H_5)_2^+$ at irradiated n-type Si; (ii) synthesis of hydrolytically unstable ferrocene derivatives for attachment to surfaces; trichlorosilylferrocene, I, (l,l'-ferrocendiyl)dichlorosilane, II, and l,l'-bis(triethoxysilyl)ferrocene, III, have been prepared; (iii) pretreated (oxidized) Pt surfaces have been derivatized with I-III and (iv) n-type Si has been successfully derivatized with II and III. Characterization of derivatized surfaces by cyclic voltammetry reveals persistently attached electroactive material. For the n-type Si the derivatization suppresses photoanodic Si → SiO/sub x/ conversion and may provide a way to use Si as a fairly general photoassistance agent for light induced oxidations.

5509 (ORO—5528-2) **Solar-induced photochemistry: photoelectrochemistry and molecular storage of solar energy. Progress report, August 1, 1977—July 31, 1978.** Fox, M.A. (Texas Univ., Austin (USA)). 1978. Contract EG-77-S-05-5528. 7p. Dep. NTIS, PC A02/MF A01.

A research program has been initiated which involves mechanistic studies into two aspects of photochemical conversion of solar energy: organic photoelectrochemistry and the storage of energy in strained organic molecules. Electrochemical techniques have been employed to demonstrate that light can produce significant photocurrents ($>10\mu amp/cm^2$) upon excitation of several highly-absorptive carbanions, radical anions, and aromatic hydrocarbons. The use of these excited state species in constructing stable photogalvanic cells has been attempted. Preliminary results indicate significant

dependence on the spatial relationship between the photoactive moiety and the electrode and that the efficiency of such cells are greatly dependent on the detailed environment of the absorptive molecule. The use of expensive single crystal semi-conductor electrodes is apparently not required since useful currents can be observed with polycrystalline deposition of the semiconductor. No decomposition of the electrodes is detectable after short periods of irradiation. A search for ring closure reactions in analogous carbanions has so far been unsuccessful but may yet yield to experimental modification. Two new reactions in which carbon-carbon bonds are formed have been discovered.

5510 Photo-galvano-voltaic cell: a new approach to the use of solar energy. Ti Tien, H.; Mountz, J.M. (Mich State Univ, East Lansing). *Int. J. Energy Res.;* **2**: No. 2, 197-200(1978).

A novel photo-electrochemical cell based on a combined principle of photogalvanic and photovoltaic effects is proposed and tested. The principal element of the cell consists of a pigmented membrane separating two aqueous solutions, one of which contains thionine dye and ferrous ions. The photo-e.m.f. generated across the cell is equal to the sum of the voltages derived from the photogalvanic and photovoltaic processes. The feasibility of such a photogalvano-voltaic device for light transduction has been demonstrated.

5511 Solar cells based on thin polycrystalline layers of cadmium chalcogenides deposited by thermal evaporation or chemical spraying. Chartier, P.; Fall, S.S.; Faye, M.; Cadene, M.; Cohen-Solal, G.W. (Univ. de Dakar, Senegal). *C. R. Hebd. Seances Acad. Sci., Ser. C;* **284**: No. 12, 437-440(21 Mar 1977). (In French).

The feasibility of electrochemical solar cells based on thin layers of cadmium chalcogenides deposited by thermal evaporation or chemical spraying onto an electrically conductive tin oxide coated glass substrate is experimentally demonstrated.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 5464, 5515, 5519

5512 (CONF-771203—, pp 627-628) **Construction of satellite power stations from nonterrestrial materials: feasibility and economics.** O'Leary, B. (Princeton Univ., NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5513 (TID—28780) **Energy storage for photovoltaic conversion. Executive summary: residential and utility systems. Volume I.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 30 Sep 1977. Contract EY-76-C-04-2744. 19p. Dep. NTIS, PC A02/MF A01.

Battery energy storage was assessed for both photovoltaic powered residences in sever geographic locations and in two utility networks, incorporating photovoltaic plants, in the United States. For both systems, candidate batteries, their screening and final battery selection are described, and preliminarily designed, as are all auxiliary battery systems and the interfacing power conditioning equipment. Technical and institutional problems, related to battery storage in these applications, are defined, as well as plans and/or means of overcoming them. Methods for disseminating the information obtained in this study are related. Two follow-on and one new program, to build upon the base established by this program, are described.

5514 Solar energy transmission with microwave from orbiting power station. Monti Guarnieri, G. *Elettrotecnica;* **65**: No. 2, 117-121(Feb 1978). (In Italian).

The solar energy from an orbiting station can be transmitted to the earth with a narrow beam of microwave and received by a phased array antenna followed by rectifiers (rectenna). With antenna of reasonable size the transmission efficiency of the entire system can reach 66%.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 5381, 5464, 5512, 5514, 5539, 5598, 5642

5515 (CONF-771203—, pp 607) **Dual purpose solar-electric power plants.** Hall, F.F. (Hydro-Sol Corp., Mountain View, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5516 (CONF-771203—, pp 629) **SOLARES: a new hope for solar energy.** Billman, K.W.; Gilbreath, W.P.; Bowen, S.W. (NASA-Ames Research Center, Moffet Field, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5517 (SAND—78-8015) **Semiannual review of solar thermal central power systems.** (Sandia Labs., Livermore, CA (USA)). Apr 1978. Contract CY-76-C-04-0789. 230p. Dep. NTIS, PC A11/MF A01.

An overview of the US DOE and EPRI programs associated with solar thermal central power systems is presented. Twenty-four papers are included that outline the status of various DOE-funded projects. (WHK)

5518 (SAND—78-8020) **Sensitivity study of Brayton cycle power plant performance.** Hiller, C.C. (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

This study investigates the efficiency of Brayton cycle power plants under a variety of design configurations. The study is unique in that the range of cycle parameters and configurations examined is beyond that generally discussed in the open literature. The parameters and configurations include: open and closed air cycles, optimum pressure ratio, helium versus air working fluids, turbine and compressor isentropic efficiencies, recuperator effectiveness, turbine inlet temperature, heat rejection temperature, pressure drop losses, with/without intercooling, and with/without reheat. Equation derivations, a computer listing, and a hand calculator program listing are included in the appendices so that variations other than those presented may be studied.

5519 (TID—28589) **Study of the feasibility of utilizing solar, wind, and geothermal energy in Hobbs, New Mexico. Final report. Volume 1. Executive summary.** Taylor, B.J.; Huettner, D.A; Murry, D.; Horrell, J.; Ingene, C. (Oklahoma Univ., Norman (USA). Center for Economic and Management Research). 2 Jun 1978. Contract EY-76-S-05-5231. 32p. Dep. NTIS, PC A03/MF A01.

The economic feasibility of interfacing a solar prototype system with the privately owned utility at Hobbs, New Mexico, is explored. Geothermal and wind energy were eliminated from consideration. The following were discussed: technical efficiency of solar systems, thermal only system, recommended options with and without storage, and solar system rankings with various fuel cost inflation rates. (MHR)

CENTRAL RECEIVER

5520 (CONF-771203—, pp 231-234) **Results of a tilt—tilt low profile heliostat test program.** Brown, G.L. (Honeywell, Inc., St. Petersburg, FL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5521 Spinning a turbine with sunlight. *EPRI J.;* **3**: No. 2, 14-19(Mar 1978).

Current research on solar power generation focuses on testing designs to be used for pilot plants, developing higher conversion efficiencies, and reducing the cost of hardware. Designers envision solar beams reflected up to boilers on top of a tower and connected to a system of heat exchangers and a turbine generator; but little is known of the best size, configuration, the energy requirements from utilities, the energy storage potential, or the cost. An eight-year chronology of parallel and complementary R and D programs conducted by the Federal government and The Electric Power Research Institute is reviewed. Both parties have sought a commercially viable power tower design for electricity generation and to allow fuel and capacity displacement for other purposes.

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 5613

5522 (CONF-771203—, pp 655-656) **Solar-plus-fuel distributed air turbine/generating system.** Cooper, E.E. (Naval Construction Battalion Center, Port Hueneme, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 5509

5523 (CONF-771203—, pp 101-103) **Major factors in OTEC heat exchanger design.** Yung, D.; Lorenz, J.J.; Sather, N.F. (Argonne National Lab., IL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5524 (CONF-771203—, pp 105) **Alternate forms of energy transmission from OTEC plants.** Talib, A.; Konopka, A.; Biederman, N.; Blazek, C.; Yudow, B. (Inst. of Gas Tech., Chicago). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5525 (CONF-771203—, pp 107-108) **Ocean thermal energy conversion (OTEC) plant working fluid study.** Nelson, M.I. (Honeywell DSD Div., Hopkins, MN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5526 (CONF-771203—, pp 109-110) **Innovative heat exchanger concepts for ocean thermal energy conversion (OTEC) systems.** Pfluger, A.R.; Manikowski, A.F. (Lockheed Missiles and Space Co., Sunnyvale, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5527 (CONF-771203—, pp 887-889) **Salinity power station at the Swedish West-Coast. Possibilities and energy-price for a 200 MW-plant.** Emren, A.T.; Bergstroem, S. (Univ. of Goteborg). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5528 (CONF-771203—, pp 15) **Motion picture treatment of ocean thermal energy conversion.** Naef, F.E. (Lockheed Ocean Systems, Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5529 (CONF-771203—, pp 17-18) **Major factors in ORTEC power cycle design.** Clinch, J.M. (Argonne National Lab., IL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5530 (CONF-771203—, pp 19-20) **Update of OTEC baseline design.** Curto, P.A. (Mitre Corp., McLean, VA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5531 (CONF-771203—, pp 21) **Commercialization of OTEC: problems and opportunities.** Lavi, G.H. (Carnegie-Mellon Univ., Pittsburgh). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5532 (COO—4683-1) **Evaluation of mixing and recirculation in generic OTEC discharge designs.** Fry, D.J.; Adams, E.E.; Jirka, G.H. (Massachusetts Inst. of Tech., Cambridge (USA); Cornell Univ., Ithaca, NY (USA)). 1977. Contract ET-78-S-02-4683. 15p. Dep. NTIS, PC A02/MF A01.

The results of an experimental and analytical study of the external fluid mechanics of generic OTEC designs, which was conducted at M.I.T's R. M. Parsons Laboratory for Water Resources and Hydrodynamics from March 1976 to July 1977, are summarized. In this study it was concluded that plants of 100 to 200 MW, utilizing mixed evaporator and condenser discharges, could be designed to operate with no recirculation under typical ocean conditions. The primary design variables affecting recirculation were identified and recommendations for future research were made. Also, a continuing study of near-field mixing processes currently underway at M.I.T. and study of the intermediate field disturbances of the ambient ocean now underway at Cornell University are outlined.

5533 (DOE/ET—0021/1) **Ocean Thermal Energy Conversion (OTEC) program. FY 1977 program summary.** (Department of Energy, Washington, DC (USA). Div. of Solar Technology). Jan 1978. 201p. Dep. NTIS, PC A10/MF A01.

An overview is given of the ongoing research, development, and demonstration efforts. Each of the DOE's Ocean Thermal Energy Conversion projects funded during fiscal year 1977 (October 1, 1976 through September 30, 1977) is described and each project's status as of December 31, 1977 is reflected. These projects are grouped as follows: program support, definition planning, engineering development, engineering test and evaluation, and advanced research and technology. (MHR)

5534 (DSE—2426-20) **Alternative energy transmission systems from OTEC plants. Project 8980 final report, June 1976—July 1977.** Konopka, A.; Talib, A.; Yudow, B.; Blazek, C.; Biederman, N. (Institute of Gas Technology, Chicago, IL (USA)). Sep 1977. Contract EX-76-C-01-2426. 243p. Dep. NTIS, PC A11/MF A01.

Techno-economic analyses are presented of three different methods of using shaftpower derived from an ocean thermal energy conversion (OTEC) plant to obtain currently usable forms of energy. "High-energy" fuels were studied to determine the initial feasibility of their synthesis on-board an OTEC plant. Fuels studied were hydrazine hydrate, anhydrous hydrazine, unsymmetrical dimethylhydrazine, 1,7-octadiyne, and tetrahydrodicyclopentadiene. Carbonaceous fuels considered were methanol, gasoline, and methane. Transportation and terminal facilities for delivering and receiving the offshore-produced energy carriers were assessed. Thermal energy media were considered as both methods of storage and transportation of OTEC-derived energy. The characteristics of the storage medium, storage configuration and materials, system energy storage density, system thermal losses, heat energy efficiency, and cycle temperature are specified. The unit capital costs of storage, transport ships, and heat engines are also discussed. The methodology for the economic evaluation of the thermal energy transport system is also described. The ship transport concept description, the economic evaluation methodology, and the results for the costs for delivered thermal energy and electricity are given. Two "electrochemical bridge" techniques hold promise as alternate methods of OTEC electrical energy transport for long offshore distances where cables are impractical. Overall conclusions and recommendations were made based on the results of the entire study and are discussed.

5535 **Marine thermal energy and the combination of solar, radiative and wind energies.** Dauvillier, A. *Rev. Energ.;* **29**: No. 302, 142-145(Mar 1978). (In French).

A thermodynamic process for the generation of energy is presented which uses meteorological elements through the creation of a heat source due to day-time rays and a cold source due to night-time rays plus a minor addition of wind energy, obtained by a heat pump. Marine thermal energy, the radiation process, wind energy and the problem of sites and construction are all successively studied in this article.

5536 **Earth as a solar heat engine.** *EPRI J.;* **3**: No. 2, 43-48(Mar 1978).

Indirect solar energy sources, including wind and ocean wave power, ocean-thermal gradients, and biomass conversion, have been reclassified in the category of solar power. Each has unresolved technical, environmental, and social problems and none is expected to contribute more than one or two percent of future U.S. power demand. The status of current technology, basic concepts, potential problems, and research efforts are reviewed for each of the four sources. Although each represents a "long-shot" promise, there is growing interest in developing the potential energy for appropriate applications.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 5445, 5471

5537 (CONF-771203—, pp 481-483) **Local soil warming by solar energy.** LaRosa, R. (Hazeltine Corp., Greenlawn, NY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5538 (LLL/M—085) **Small business opportunities solar energy handbook: Southern California Region.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jan 1978. Contract W-7405-ENG-48. 328p. Dep. NTIS, PC A15/MF A01.

The purpose of this handbook is to provide small business management with factual information on solar energy technology and to document the varied business opportunities that exist in the field. The handbook covers the following areas: business opportunities (role definitions, products and application, getting started); business development (marketing and market penetration; market analysis and projections, insurance and liability, government programs); solar components and systems (collectors, storage, service hot-water systems, space heating with liquid and air systems, space cooling, heat pumps and controls, etc.); computer programs for system optimization (performance and cost); local solar and weather data; solar legislation; standards, codes, and testing; solar buildings in the region; solar firms (manufacturers, distributors, and solar energy services in the Southern California region); and finally access to sources of information. (MHR)

5539 (SAND—78-1315) **User's manual for computer code SOLTES-1 (simulator of large thermal energy systems).** Fewell, M.E.; Grandjean, N.R.; Dunn, J.C.; Edenburn, M.W. (Sandia Labs., Albuquerque, NM (USA)). Sep 1978. Contract EY-76-C-04-0789. 251p. Dep. NTIS, PC A12/MF A01.

SOLTES simulates the steady-state response of thermal energy systems to time-varying data such as weather and loads. Thermal energy system models of both simple and complex systems can easily be modularly constructed from a library of routines. These routines mathematically model solar collectors, pumps, switches, thermal energy storage, thermal boilers, auxiliary boilers, heat exchangers, extraction turbines, extraction turbine/generators, condensers, regenerative heaters, air conditioners, heating and cooling of buildings, process vapor, etc.; SOLTES also allows user-supplied routines. The analyst need only specify fluid names to obtain readout of property data for heat-transfer fluids and constants that characterize power-cycle working fluids from a fluid property data bank. A load management capability allows SOLTES to simulate total energy systems that simultaneously follow heat and power loads and demands. Generalized energy accounting is available, and values for system performance parameters may be automatically determined by SOLTES. Because of its modularity and flexibility, SOLTES can be used to simulate a wide variety of thermal energy systems such as solar power/total energy, fossil fuel power plants/total energy, nuclear power plants/total energy, solar energy heating and cooling, geothermal energy, and solar hot water heaters.

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 5465, 5466, 5467, 5473, 5576, 5629, 6040, 6092, 6112

5540 (BNL—24637) **Glazing and the Trombe wall.** Pouder, R.W.; Leigh, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 4p. (CONF-780808—18). Dep. NTIS, MF A01.

From Meeting of the American Section of the International Solar Energy Society; Denver, CO, USA (28 Aug 1978).

Portions of document are illegible.

Single, double and triple glazing are examined for use in passive solar Trombe walls and south facing windows. Net gains and losses are calculated employing regional weather data and annual contribution to heating load reduction is evaluated. The study concentrates on the reflectivity of each glass pane, including the dependence of reflectivity on the angle of incidence of the radiation, and resulting heat gains and losses. This facet of passive design heretofore has been inadequately treated as is shown to be significant. The marginal value of each additional pane is investigated with regard to heat gain, energy savings and total costs. Additionally, attention is given to the effects of Trombe wall energy storage.

5541 (CONF-770966—, pp 121-125) **Solar heating of commercial greenhouses.** Cummings, R.D.; Cummings, G.J. (Daystar Corp., Burlington, MA). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

Daystar Corporation will construct a detached module for the heating of commercial greenhouses. The module, with a gross solar collecting aperture area of 5,000 ft², will have the shape of a right triangular prism of 150′ x 20′ base and 30′ height. The module will be glazed with low iron glass and Daystar selective structure heat trap. University of Massachusetts will monitor the compatibility of the greenhouse plants to the module heating. S. A. Peterson (Growers) will assist in monitoring the performance of the system.

5542 (CONF-770966—, pp 127-130) **SAVE-GAS: Solar Agricultural Viability Enhancement - Greenhouse Augmentation System.** Collins, D.L. Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

Augmentation of the inherent solar collection capability of commercial greenhouses through application of hybrid solar technology can be achieved economically. The use of the patented Solargenics SMART Collector provides higher energy at low installed cost. Through simplified analysis, a modular system can be mechanized which can reduce operating fuel costs by 50%. The cost impact of the solar system is treated on a Return-On-Investment basis, and has been shown to have economic viability at ROIs as low as 15%. The present system will be operational by early this December, and preliminary validation data will be available in May of 1978.

5543 (CONF-770966—, pp 131-136) **Kube Pak Greenhouse solar heating demonstration.** Mears, D.R.; Roberts, W.J. (Cook Coll., New Brunswick, NJ). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

The performance of Rutgers' prototype greenhouse solar heating system has shown sufficient promise to justify the construction of a commercial demonstration. A new greenhouse section of 0.5 hectares at the Kube Pak Corporation, Allentown, New Jersey is being built for this purpose.

5544 (CONF-770966—, pp 137-143) **Solar heating of commercial greenhouses.** Staton, B.G. (Lockheed Research and Engineering Center, Huntsville, AL). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

The objective of this project is to demonstrate the feasibility of heating a commercial greenhouse using solar energy. The greenhouse operator participating in this project is the Ulery Greenhouse Company in Springfield, Ohio. A 6000 square foot flat plate collector system will be built to heat an 8650 square foot greenhouse area. The solar system will provide approximately 60% of the total heat requirement.

5545 (CONF-770966—, pp 145-149) **Integral solar-collector greenhouse using high-performance solar glazing (solar membrane).** Tilford, C. (Suntek Research Associates, Corte Madera, CA). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

This project is an integral solar-heated greenhouse retrofit with rock-pile storage. Suntek Research Associates has developed plastic glazing which, when installed in three layers, transmits 85% of solar radiation vs 61% for glass. This "Solar Membrane" will replace polyethylene on a 120′ x 30′ steel arch house in Northern California.

5546 (CONF-770966—, pp 199-208) **Performance reporting format for solar heating and cooling systems.** Allen, R.W. (Univ. of Maryland, College Park). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

A reporting format for solar heating and cooling systems, which is in use in an international information exchange pilot study known as the Solar Energy Pilot Study of the NATO Committee on the Challenges of Modern Society (CCMS), is discussed in order to highlight the details many of which will merit coverage in future solar industrial process heat performance reports. The CCMS System Reporting Format is divided into sections. The first section

includes: (1) a general description of the project and environment, including a brief description of the purpose and strategy of the project; (2) a general description of the climate location, insolation, temperature, and wind features of the test site; and (3) a description of the system being tested. The second section prescribes the items to be covered in the reporting of thermal performance of the system. The third section covers the economic aspects, including various costs and economic factors, as well as maintenance and user reaction information. A fourth section deals with subsystem performance and prescribes the required descriptive information on the collector subsystem, the storage subsystem, etc., as well as the type of thermal performance characteristics that are to be reported on these subsystems. Material from a typical CCMS Format Report is presented in condensed form to illustrate the content of the various sections of the CCMS System Reporting Format.

5547 (CONF-771203—, pp 223) **Integration of solar energy in the built environment.** Casalonga, P.F.M. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5548 (CONF-771203—, pp 249-251) **Progress report on the University of Louisville Dual Solar Energy Research Center.** Murray, T.M.; Bordoloi, K.C. (Univ. of Louisville, KY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5549 (CONF-771203—, pp 273-275) **Economic comparison between solar and conventional residential air conditioning in Miami, Florida.** Rotolante, B.H. (Univ. of Miami, Coral Gables, FL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5550 (CONF-771203—, pp 409-410) **"Sunbird I": Utah's first commercial solar home.** Young, G.W. (Ford, Bacon, and Davis, Salt Lake City). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5551 (CONF-771203—, pp 411-413) **Domestic solar heating and cooling system for Kuwait and Saudi Arabia.** Puri, V.M.; Malik, M.A.S. (Kuwait Inst. for Scientific Research). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5552 (CONF-771203—, pp 415-417) **Design curves for a solar heated and cooled Kuwaiti home.** Puri, V.M.; Malik, M.A.S. (Kuwait Inst. for Scientific Research). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5553 (CONF-771203—, pp 419-421) **Honeywell General Offices solar HVAC system.** Block, R.F.; Waters, D.E. (Honeywell Inc., Minneapolis). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5554 (CONF-771203—, pp 423-424) **Refined model of solar space cooling system.** Jenks, R.L. (Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia); Kremheller, A.; Rogers, W.A.; Jones, R.W. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5555 (CONF-771203—, pp 425-427) **Solar energy system for space heating and space cooling.** McNamara, T.J. (V.A. Scavo and Associates, Chicago). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5556 (CONF-771203—, pp 433-435) **Dehumidification by solar energy.** Arnas, O.A. (Louisiana State Univ., Baton Rouge). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5557 (CONF-771203—, pp 437) **Liquid sorbent solar air conditioner.** Robison, H. (Univ. of South Carolina, Conway). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5558 (CONF-771203—, pp 633-635) **Computer modelling of solar energy collection.** Farag, I.H.; Neville, M. (Univ. of New Hampshire, Durham). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5559 (CONF-771203—, pp 653-654) **Development and implementation of a microprocessor based instrumentation subsystem for solar energy applications.** Spencer, C.A.; Payton, R.; Murray, T.M. Jr. (Univ. of Louisville, KY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5560 (CONF-7710136—, pp 187-196) **Solar energy system for space heating and space cooling.** McNamara, T.J. (V. A. Scavo and Associates, Chicago). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

To help reduce natural gas and electrical operating costs, a retrofit space-heating and space-cooling solar system is integrated into the existing conventional heating and air-handling systems serving the exhibit spaces of the Museum of Science and Industry, Chicago. This installation would not only provide substantial energy cost savings to the Museum, but would also provide a means of showing and explaining the operation of an actual working solar-energy system to the large number of daily visitors to the Museum. The design, operation, and performance of this system are explained.

5561 (DOE/CS—0007) **National program for solar heating and cooling of buildings.** (Department of Energy, Washington, DC (USA)). Jul 1978. 60p. Dep. NTIS, PC A04/MF A01.

The results of a continuing assessment of program plans, additional program activities, and experience gained and achievements made since program inception are reflected here. The current status of program activities funded totally or partially by DOE is presented in this report which thus supersedes ERDA 76-6. (MHR)

5562 (DOE/CS—0038) **National Solar Heating and Cooling Commercial Demonstration Program: key personnel directory.** (Department of Energy, Washington, DC (USA). Div. of Solar Applications Developments). Jun 1978. 121p. Dep. NTIS, PC A06/MF A01.

Firms and individuals who are principal participants in the DOE solar heating and cooling demonstration projects for Federal and non-Federal commercial buildings and Federal residential buildings are identified. The directory is intended to facilitate communication with, and among, active participants in demonstrations of solar heating and cooling technology currently sponsored by DOE. When available, identifying information has been provided for owners, architects, solar designers, mechanical engineers, builders, and other key personnel directly involved in each project. (MHR)

5563 (DOE/ET—0063) **Solar '77.** Wenzel, G. (Department of Energy, Kansas City, MO (USA). Region VII). Jun 1978. 44p. Dep. NTIS, PC A03/MF A01.

This manual was designed to give everyone a basic understanding of necessary conservation and system features for an effi-

cient, cost effective, and comfortable solar tempered dwelling. Primary emphasis was given to energy efficient design features and construction in new and existing dwellings. A solar glossary is included. (MHR)

5564 (DOE/NASA/CR—150525) **Quarterly reports on prototype solar heating and hot water systems.** (Colt, Inc., Rancho Miroge, CA (USA)). Jan 1978. Contract EX-76-A-29-1037. 24p. Dep. NTIS, PC A02/MF A01.

Four quarterly reports that cover the progress made in the development of a solar hot water and space heating system are presented. The program schedules, technical status, and other program activities from October 6, 1976 through September 30, 1977. The system itself is not described.

5565 (DOE/NASA/CR—150604) **Pump/control system minimum operating cost testing.** (Tennessee Technological Univ., Cookeville (USA). Dept. of Mechanical Engineering). 7 Dec 1977. Contract EX-76-A-29-1037. 71p. Dep. NTIS, PC A04/MF A01.

This study was not directed at ranking or recommending specific pumps available for use in solar systems. The primary purpose was to assess the trends in factors affecting energy usage in typical prime movers which might be used in liquid transport solar systems. Since this is not a comprehensive study, using only arbitrarily selected pumps, the reader is cautioned against selecting a pump from this report based purely on the data contained herein. In particular, important aspects of pump selection such as durability, materials compatibility, safety, and other significant features were not addressed in this study. Only a small arbitrary selection of a representative cross section of available pumps was tested; therefore, other pumps may exist which are superior to those discussed. Results are presented and discussed.

5566 (DOE/NASA/CR—150743) **Installation package for 77-180 SOLARSTAT and 77-171 controller.** (Solar Control Corp., Boulder, CO (USA)). Jul 1978. Contract EX-76-A-29-1037. 24p. Dep. NTIS, PC A02/MF A01.

The information necessary to install, operate, and maintain Solar Control Corporation's Solar Thermostat "Solarstat" and their "Basic Modular Controller" is given. Contained within the report are the Installation, Operation, and Maintenance Manuals, Specifications, standard features and the Underwriter Labs Certification Statement.

5567 (DOE/NASA/CR—150771) **Solar control design package.** (Solar Control Corp., Boulder, CO (USA)). Aug 1978. Contract EX-76-A-29-1037. 54p. Dep. NTIS, MF A01.

Portions of document are illegible.

Information used in the evaluation of design of Solar Control's solar heating and cooling system controller and the Solarstat is presented. System performance specifications, design data brochures, and detailed design drawings are presented.

5568 (EPRI-ER—843) **Comparison of solar absorption and vapor compression residential cooling systems. Interim report.** Lawley, T.J. (Texas Univ., Arlington (USA)). Aug 1978. 39p. Dep. NTIS, PC A03/MF A01.

Texas Electric Service Company and the University of Texas at Arlington are performing testing for the direct comparison in the same facility of solar powered absorption cooling and solar assisted, electric powered heat pump cooling for a single family residence. Solar hot water heating and space heating with electric resistance and heat pump heating as back-ups are also included. The facility is a 1550 square foot residence which has been constructed as a solar energy research facility on the campus of the University of Texas at Arlington. A complete description of the facility is presented with emphasis on the solar heating and cooling equipment and the associated instrumentation. Calculated heating and cooling loads are presented with design predictions as to the degree of solar participation. A review of start-up and operating difficulties which have occurred since the facility has been constructed is also included. The program is beginning the second year of a two year test plan.

5569 (HCP/M4038—01(Rev.)) **Fundamentals of solar heating: correspondence course.** (Sheet Metal and Air Conditioning Contractors National Association, Vienna, VA (USA)). Aug 1978. Contract EG-77-C-01-4038. 190p. Dep. NTIS, PC A09/MF A01.

This revision is the August 1978, reprinting of HCP/M4038--01 which has appeared previously.

5570 (LA-UR—78-1589) **Simulation of passive solar buildings.** Balcomb, J.D. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 4p. (CONF-780337—7). Dep. NTIS, PC A02/MF A01.

From 2. national passive solar conference; Philadelphia, PA, USA (15 Mar 1978).

The use of simulation analyses as both a design and an evaluation tool is discussed. The reasons and techniques of simulation analysis are described and various possibilities discussed.

5571 (NP—23380) **Assessment of solar heated buildings and panels. Progress report No. 12. Final report, January 1, 1977—December 31, 1977.** Converse, A.O. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Jan 1978. 18p. Dartmouth College, Hanover, NH.

The findings of a three-year program to evaluate the performance of solar heat installations are summarized. It is noted that the Northeast is one of the more favorable regions in the country for solar heating, and government policies and engineering studies are suggested that are needed to further the utilization of solar energy in this region. The establishment of regional experimental stations is strongly supported.

5572 **Solar heated shelter with moveable secondary roof.** Lipinski, V.B. US Patent 4,067,347. 10 Jan 1978. Filed date 30 Jan 1976. 8p.

A portable solar heated shelter is described comprising at least one fixed roof layer and a second roof layer which can be selectively deployed to vary the thermal characteristics of the shelter. The shelter preferably comprises a rigid frame on which first and second end walls are preferably pivotally mounted. The end walls are preferably foldable between a vertically upright operative position and a generally horizontal, lowered storage position, and when deployed support the roof layers to define the enclosure. The second roof layer is adapted to be unwound from a storage spool and drawn into a take-up spool, passing over the first roof layer, by a cranking action. The second roof layer preferably comprises a first sunshade portion and a series connected heat insulative portion of opaque material which may be selectively deployed to control the thermal characteristics of the enclosure.

5573 **Solar heating and cooling of residential buildings: design of systems.** Washington, DC; Dept. of Commerce (Oct 1977). 200p. $8.25.

This course is designed to train home designers and builders in the fundamentals of solar hydronic and air systems for space heating and cooling and domestic hot water heating for residential buildings. The following topics are covered: course orientation; general descriptions of solar heating and cooling systems; solar radiation information for design purposes; system design guidelines; heating and cooling load analyses; simplified design calculations; detailed design methods; economic considerations; energy conservation trade-offs; detailed calculations; collectors; storage systems; laboratory; computer-aided f-chart calculations; system controls; selection of subsystem components; solar cooling systems; automated design techniques; service hot water systems; design case study; structural, mechanical, and scheduling considerations; future prospects for solar heating and cooling systems; and buyer's guide. (MHR)

5574 **Solar energy: fundamentals in building design.** Bruce Anderson. Harrisville, NH; Total Environmental Action, Inc. (1977). 383p. $21.50.

The following areas are covered: good building design, passive uses of solar energy, complex solar HVAC systems, and solar water heating. The major methods of using solar energy for heating and cooling buildings and water heating are compared, evaluated, and critiqued. Rules for evaluating products and materials are included. (MHR)

5575 **How to understand solar energy technology and economics.** Hampton, NH; Solar Data ([nd]). 86p. $6.50.

Solar energy for space and water heating is discussed. Specifically several types of solar heating systems are investigated, including both built-in and retrofitted air and water systems. Solar power is examined for space heating, for hot water heating, and for a combination of both uses. It is found that solar heating systems are often economically feasible at today's prices for use by electrically heated buildings. Furthermore, it is argued that solar systems should be immediately considered for commercial buildings which demand large amounts of hot water. Nine recommendations for state action and six recommendations for federal action are included. The following topics are covered: the use of solar energy collectors, differences in solar heating systems, the economics of solar heating systems, solar energy applications, and state strategies for promoting solar development. (MHR)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 5601

5576 (CONF-770966—) **Proceedings of the solar industrial process heat symposium.** (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). Jun 1978. Contract EG-77-C-01-6079. 228p. Dep. NTIS, PC A11/MF A01.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

The purpose of the symposium was to review the progress of various solar energy systems currently under design for supplying industrial process heat. Formal presentations consisted of a review of solar energy applications in industrial process heat as well as several on-going project reviews. An Open Forum was held to solicit the comments of the participants. The recommendations of this Open Forum are included in these proceedings. Eighteen papers were included. Separate abstracts were prepared for each paper.

5577 (CONF-770966—, pp 1-22) **Review of the use of solar energy for industrial process heat.** Anand, D.K. (Univ. of Maryland, College Park). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

The results of two surveys of the use of solar energy in industrial process applications are reviewed, first separately and then to try and find some common ground. The conclusions of the surveys are compared. The industries reviewed are listed and process heat requirements are summarized for some. Fuel cost projections and the potential for solar energy are included. (MHR)

5578 (CONF-770966—, pp 23-37) **Solar energy for industrial process hot water.** Vindum, J.O. (Acurex Corp., Mountain View, CA). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

Acurex Corporation is designing, constructing and will evaluate a solar energy system for supplying industrial process hot water. At the Campbell Soup plant in Sacramento, California, solar-heated water will be used to wash empty and full soup cans on one of twenty parallel can-washing lines. The solar collector field is made up of a combination of single-glazed, nonselective flat-plate and parabolic trough concentrating collectors.

5579 (CONF-770966—, pp 39-55) **Application of solar energy to the supply of hot water to manufacture cement blocks.** Wilkening, H.A. Jr. (AAI Corp., Baltimore). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

AAI Corporation is currently working on Phase II of a contract to design and build a solar augmented hot water system for curing concrete blocks. The collector array includes 9216 square feet of AAI's 24/1 concentrating collector system. The collectors will be applied to a new block plant near Harrisburg, PA, owned by York Building Products Company.

5580 (CONF-770966—, pp 57-81) **Experimental solar energy system to provide process hot water for textile dyeing.** Trice, J.B.; Haas, S.A.; Savitsky, E.J.; Duff, T. (General Electric Co., Philadelphia). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

Phase I of a three phase program to design, build and evaluate an experimental solar energy process hot water system for textile dyeing is summarized. The artist's sketch shows the textile plant and the 6680 square foot solar collector field that will supply 190°F water to an 1100 gallon dyeing tank at Riegel Textile Corporation's LaFrance, South Carolina facility.

5581 (CONF-770966—, pp 83-97) **Application of solar energy to industrial food dehydration.** Carnegie, E.J.; Niles, P.W. (California Polytechnic State Univ., San Luis Obispo, CA). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

The Application of Solar Energy to an Industrial Raisin Dehydration plant in Fresno, California is discussed. Included is Phase I, the design and system analysis and part of Phase II, the construction. The estimated costs and the actual costs are compared.

5582 (CONF-770966—, pp 99-109) **Solar industrial process heat for kiln drying lumber.** Robertson, S.J.; McCormick, P.O. (Lockheed Research and Engineering Center, Huntsville, AL). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

A solar heating system is being constructed which will provide 40% of the heat energy required by a 50,000 bd ft kiln drying hardwood lumber. The system includes 2500 ft^2 of Chamberlain liquid heating collectors and 2400 ft^2 of anodized aluminum reflector in a sawtooth arrangement. The storage medium is water (5000 gal) which is circulated through the collectors and heat exchangers. The heat exchangers are placed in the air flow of existing fans that circulate air through the lumber. The system is being constructed at the J. A. LaCour Kiln Service facility in Canton, Mississippi.

5583 (CONF-770966—, pp 111-120) **Soybean drying using heat from solar energy.** Guinn, G.R.; Fisher, P.N. (Teledyne Brown Engineering, Huntsville, AL). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

The objective of this project is to provide for the analysis, design, fabrication, testing, and demonstration of a solar energy system for process drying of soybeans. An array of 672 air collectors will be used to temper the inlet air to the existing continuous-flow dryers at the Gold Kist Soy facility at Decatur, Alabama.

5584 (CONF-770966—, pp 161-170) **Solar production of industrial process hot water using shallow solar ponds.** Guinn, G.R.; Hall, B.R. (Teledyne Brown Engineering, Huntsville, AL). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

The object of this effort is to demonstrate the performance and economic feasibility of shallow solar ponds (SSPs) for the production of industrial process hot water. Eight SSPs, each measuring 11.5 ft by 180 ft by 4 in. average depth, will heat 41,000 gal/day of process water for a poultry canning operation.

5585 (CONF-770966—, pp 171-178) **Textile drying using solarized cylindrical can dryers.** Mitchell, P.D.; Gupta, B.P. (Honeywell Inc., Minneapolis). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

A solar energy system is described for providing process heat to a textile drying process. The solar collection subsystem uses 700 square meters of parabolic trough, single axis tracking, concentrating collectors to heat water in a high temperature water loop. A steam generator is fueled with the HTW to produce process steam. The process being solarized is textile drying using cylindrical can dryers. The can dryers are part of a "slashing" operation in a WestPoint Pepperell mill in Fairfax, Alabama.

5586 (CONF-770966—, pp 179-187) **Economics and market projections for solar process heat delivery systems.** Curto, P.A. (Mitre Corp., McLean, VA). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

Engineering cost and performance estimates are presented for solar process heat delivery systems for the agricultural/industrial process heat market sector and some preliminary market projections for solar equipments.

5587 (CONF-770966—, pp 189-198) **Need for government economic incentives to promote the use of solar energy for industrial process heat.** Dickinson, W.C. (Univ. of California, Livermore). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

The average installed costs of industrial solar systems now being constructed under ERDA funded projects are considerably too high to make them attractive to industry. Cost reductions of a factor of two to three can be projected but a factor of about ten is needed to provide industry with a reasonable rate-of-return. This gap can be closed if the government provides some effective "fuel-savings" incentives to industry. The effects of different possible incentives are illustrated.

5588 (CONF-771203—, pp 257-259) **Opportunities for solar energy in California industry, agriculture and commerce.** Barbieri, R.H.; Pivirotto, D.S. (Jet Propulsion Lab., Pasadena, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5589 (UCRL—81348) **Solar industrial process heat: economic and other barriers.** Dickinson, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jun 1978. Contract W-7405-ENG-48. 13p. (CONF-780639—7). Dep. NTIS, PC A02/MF A01.

From Analysis for solar heating and cooling; San Diego, CA, USA (27 Jun 1978).

Experience with experimental industrial solar-energy systems, along with field and laboratory research, has led to several design criteria and guidelines for solar industrial process-heat systems. The current cost of solar-energy systems must be reduced by at least half before such systems will be economical for industry. Outside of the southwestern United States, the lower amount of available solar energy dictates that solar-energy systems cost even less to be economical. Lack of adequate space for collectors limits retrofit applications, but this problem will probably not be serious in new industrial plants. Water-heating collectors are generally preferred over air-heating. Lower collection temperatures mean a less expensive, probably more efficient system. Cogeneration and waste-heat utilization, where applicable, will probably take precedence over the use of solar energy. The need for and cost of heat storage can often be eliminated by connecting the solar-energy system in series, rather than in parallel, with the main process-heating system.

WATER HEATING

REFER ALSO TO CITATION(S) 5465, 5467, 5553, 5558, 5564, 5567, 5568, 5569, 5573, 5574, 5575, 6040, 6092

5590 (FSEC-TN—78-3) **Performance analysis of swimming pool solar heating in Florida.** Talwar, R. (Florida Solar Energy Center, Cape Canaveral (USA)). 1978. 4p. TIC.

The goal of a performance analysis of swimming pool solar heating is an estimate of the pool's bulk temperature. The pool temperature can be estimated by calculating an energy balance for a typical day for each month of the year. This may be done by equating the heat gains to the heat losses from the pool surface at the equilibrium pool temperature. Expressions and equations for the following are included: heat gains, heat losses, overall energy balance effect of pool covers, and analysis for special plastic pipes. (MHR)

5591 (NP—23361) **No heat, no rent: an urban solar and energy conservation manual. CSA pamphlet 6143-7.** Christianson, M.; Dearborn, H.; Finch, T.; Golubov, M.; Norris, D.; Shaw, C.; Tabor, A. (Energy Task Force, Inc., New York (USA)). Sep 1977. 98p. Community Services Administration, Energy Task Force, Washington, DC.

This manual is an introduction to energy conservation techniques suitable for a typical New York City tenement building. It is also a guide to developing and carrying out the installation and maintenance of tenant owned and operated solar domestic hot water systems. A history of the Energy Task Forces experience at 519 East 11th Street. Various conservation techniques are examined and the design and maintenance of a solar hot water system are discussed. An economic analysis is given of both the energy conservation techniques and the solar heating system. (MHR)

OTHER

5592 (CONF-771203—, pp 441-443) **Distillation of sea water using desert as the solar energy collector.** Rajvanshi, A.K.; Oliver, C.C. (Dept. of Mechanical Engineering, Gainesville, FL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5593 (CONF-771203—, pp 445-447) **Direct use of solar energy for water desalination.** Moustafa, S.M. (Western Illinois Univ., Macomb); Brusewitz, G.H.; Farmer, D.M. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5594 (CONF-771203—, pp 449-460) **Historical developments of the use of solar energy for pumping irrigation water.** Pytlinski, J.T. (Kansas State Univ., Manhattan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5595 (CONF-771203—, pp 461-469) **Basic technical and economical aspects of the use of solar energy for pumping irrigation water.** Pytlinski, J.T.; Eckhoff, N.D. (Kansas State Univ., Manhattan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5596 (CONF-771203—, pp 471-473) **Solar powered irrigation systems.** Varnado, S.G.; Vandevender, S.G.; Lukens, L.L. (Sandia Labs., Albuquerque, NM). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5597 (CONF-771203—, pp 475-479) **Solar drying house after Altenkirch.** Ataguenduez, G. (Ege Univ., Bornova-Izmir, Turkey). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5598 (CONF-771203—, pp 647-648) **Analysis of dynamic effects in solar thermal energy conversion systems.** Hamilton, C.L. (Jet Propulsion Lab., Pasadena, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5599 **Solar reactor combustion chamber.** Scragg, R.L.; Parker, A.B. (to Solar Reactor Corp.). US Patent 4,070,861. 31 Jan 1978. Filed date 3 Jun 1976. 10p.

A solar reactor combustion chamber is disclosed which includes a concrete or other suitable housing having a reactor chamber and a combustion chamber therein. A solar intensifier, such as a parabolic reflector, is mounted on top of the reactor housing. The parabolic reflector collects and intensifies solar rays and guides them through a solar sight glass, mounted on top of the housing, into the reactor chamber. The concentrated beam of light is directed onto a light disperser within the reactor chamber which disperses solar rays throughout the chamber. Molecular hydrogen and chlorine is conducted into the reactor chamber wherein in the presence of light the chlorine molecules expand into atomic chlorine. The chlorine and hydrogen molecules are forced into the combustion chamber together with oxygen wherein the chlorine and hydrogen react with controlled explosive violence to form HCl. The heat and pressure thus formed are utilized to heat or drive suitable utilization devices, such as turbines or pistons.

5600 **Solar energy system utilizing buoyancy as a conversion force.** Shaw, J.S. US Patent 4,038,826. 2 Aug 1977. Filed date 3 Mar 1975. 8p.

A closed cycle energy conversion system is described adaptable for use with, inter alia, solar collectors and other sources of available heat for increasing the temperature of a circulating fluid to a super heated condition. A substantially vertically positioned gas expander column is employed comprising an endless arrangement of cups journaled for movement in a closed path within a liquid medium in the column for trapping the super heated fluid when flashed into a gas inside a succession of the cups inverted at the bottom of the column and displacing at least a part of the liquid in the cups. A buoyancy force is thereby provided on the cups causing them to rise in the column exerting a rotating force on the endless arrangement of cups. The trapped gas is released at the top of the liquid in the column to be condensed, pressurized and recirculated to solar collectors and/or other sources of heat for reuse in the system.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 5459, 5477, 5516, 5559, 5584

5601 (CONF-770966—, pp 151-160) **Shallow solar pond design improvements.** Casamajor, A.B.; Trautt, T.A.; Flowers, J.M. III. (Univ. of California, Livermore, CA). Jun 1978.

From Solar industrial process heat symposium; College Park, MD, USA (19 Sep 1977).

In Proceedings of the solar industrial process heat symposium.

Improvements in the design of shallow solar ponds are reported. Reshaping the pond's bed improves draining at the end of the

day and improves daily efficiency by 4% at no additional cost. The glazing support structure has been redesigned to improve its ability to withstand wind and snow loads. A moisture related problem with foamed glass insulation is identified and a solution proposed.

5602 (CONF-771203—, pp 77-79) **Optimization of a fixed solar thermal collector.** Garrison, J.D. (San Diego State Univ., CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5603 (CONF-771203—, pp 80-82) **Design optimization for solar array of multiple collector types.** Bradley, J.O.; Posner, D.; Bingham, C.E. (Midwest Research Inst., Kansas City, MO). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5604 (CONF-771203—, pp 83-84) **Novel design of evacuated-concentrating spherical collector.** Bayazitoglu, Y.; Chapman, A.J. (Rice Univ., Houston, TX). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5605 (CONF-771203—, pp 85-87) **Engineering influences on the thermal performance of open-flow liquid solar collectors.** Beard, J.T.; Huckstep, F.L.; May, W.B. Jr.; Iachetta, F.A.; Dirhan, L.A. Jr. (Univ. of Virginia, Charlottesville). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5606 (CONF-771203—, pp 89-90) **Stability of air in the gap of inclined flat plate solar collectors: effects of convective boundary condition and radiation.** Oezisik, M.N.; Hassab, M.A. (North Carolina State Univ., Raleigh). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5607 (CONF-771203—, pp 91) **Performance comparison of flat plate collector absorber coatings utilizing NBS standard 74-635 collector performance methods.** Ingley, H.A.; Reinhardt, R.E. (Univ. of Florida, Gainesville). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5608 (CONF-771203—, pp 93-97) **Use of a honeycomb as solar radiation absorber and heat exchanger in an air-type solar collector.** Hightower, R.E.; Pytlinski, J.T. (Kansas State Univ., Manhattan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5609 (CONF-771203—, pp 209-211) **Further modeling of a solar collector based on linear clipped-V channels.** Bordoloi, K.C.; Murray, T.M. Jr.; Bynum, F.A. (Univ. of Louisville, KY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5610 (CONF-771203—, pp 217-219) **Analysis of a cylindrical parabolic focussing collector for distributed collector power system.** Tanaka, T.; Tani, T.; Sawata, S.; Sakuta, K.; Horigome, T. (Electrotechnical Lab., Tokyo). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5611 (CONF-771203—, pp 225-226) **Design considerations for the energy receiver in a fixed mirror-distributed focus (FMDF) solar energy system.** Clements, L.D. (Texas Tech Univ., Lubbock). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5612 (CONF-771203—, pp 227-229) **Estimating hourly solar radiation for one-axis tracking focusing collectors.** Bingham, C.E.; Posner, D.; Bradley, J.O. (Midwest Research Inst., Kansas City, MO). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5613 (CONF-771203—, pp 237-239) **Point concentrator for total energy systems application.** Levine, A.L.; Paradis, L.R.; Vallee, E.C.; Stadtlander, G.L. (Raytheon Co., Bedford, MA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5614 (CONF-771203—, pp 241-243) **Computer modelling of flat plate solar heat collectors.** Hartman, T.L. (Georgia Inst. of Tech., Atlanta); Pearce, J.B.; Clark, W.E. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5615 (CONF-771203—, pp 631-632) **Proposed floating solar energy station for producing high temperatures.** Plankenhorn, W.F. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5616 (CONF-771203—, pp 891-893) **Heat extraction from a salt gradient solar pond.** Zangrando, F.; Bryant, H.C. (Univ. of New Mexico, Albuquerque). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5617 (CONF-7710136—, pp 25-37) **Design optimization for solar array of multiple-collector types.** Bradley, J.O. (Desert Research Inst., Boulder City, NV); Posner, D.; Bingham, C.E. 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Methodology is presented for optimizing solar arrays used for heating fluids from ambient to elevated temperatures. The optimal array consists of the appropriate combination of available collector types which delivers the most energy per dollar invested in the array. An example optimization is presented and verified using computer simulation of numerous combinations of collector types.

5618 (COO—2934-6) **Study of corrosion and its control in aluminum solar collectors. Progress report, September 1, 1977—March 31, 1978.** Wong, D.; Cocks, F.H.; Giner, J. (Giner, Inc., Waltham, MA (USA)). Apr 1978. Contract EY-76-C-02-2934. 40p. Dep. NTIS, PC A03/MF A01.

Aluminum solar heat collectors operating on water/glycol heat transfer fluids are potentially attractive but for the critical problem of aluminum corrosion. A non-destructive electrochemical technique (linear polarization resistance method) was developed to determine the overall corrosion rate under various conditions. It was concluded that uninhibited ethylene glycol solutions most probably will cause catastrophic plant failure when used as a heat transfer medium in an aluminum solar collector system. The linear polarization resistance method and the pit depth measurement technique are used to evaluate the corrosion problems. In addition, a thin foil test method and an aluminum circulation panel (with a heat rejecting surface) were developed and successfully applied. The effects of using chemical scavengers for contaminants were also investigated. Also included are: (a) an investigation of the performance of the inhibited solution at high temperature ($T > 100°C$), (b) an extension

of the work to propylene glycol solutions, (c) the verification of the cube root law, and (d) the determination of the parameter a. An extensive literature review showed that phosphates, borates, nitrates, silicates and sodium mercaptobenzothiazole are the effective corrosion inhibitors used in ethylene glycol solutions.

5619 (DOE/EIA—0039/1) **Solar collector manufacturing activity and applications in the residential sector, January—June 1977.** (National Energy Information Center, Washington, DC (USA)). Feb 1978. 30p. Dep. NTIS, PC A03/MF A01.

Survey results show there are 186 companies currently manufacturing or importing medium-temperature and special solar collectors. Production during the first half of 1977 was 54 percent greater than during the second half of 1976 and 168 percent greater than 1 year ago. Results also show that there are 15 companies manufacturing low-temperature or pool heating collectors. Production of these collectors has increased by about 40 percent since the second half of 1976, and is 105 percent greater than 1 year ago. An estimate of the number of installations made in the residential sector as a result of production during this 6-month period is included. Companies reporting manufacture and sale of at least 100 square feet of solar collector are included in the appendix. (MHR)

5620 (DOE/NASA/CR—150741) **Design and installation package for the Sunmat Flat Plate Solar Collector.** (Calmac Mfg. Corp., Englewood, NJ (USA)). Mar 1978. Contract EX-76-A-29-1037. 61p. Dep. NTIS, PC A04/MF A01.

Portions of document are illegible.

The information used in evaluating the design of the Sunmat Liquid Flat Plat Plate Solar Collector developed by Calmac Manufacturing Company is presented. Included in this package are the Subsystem Performance Specification, Installation, Operation and Maintenance Manuals, collector sizing guides, and detailed drawings of the single-glazed collector.

5621 (DOE/NASA/TM—78163) **Owens—Illinois liquid solar collector materials assessment.** Nichols, R.L. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Mar 1978. Contract EX-76-A-29-1037. 36p. Dep. NTIS, PC A03/MF A01.

The Marshall Space Flight Center (MSFC) was requested by the Energy Research and Development Agency (ERDA) to assess the general suitability of the design and materials and to investigate certain failure modes of the Owens-Illinois (O-I) Sunpak solar energy collector system. The primary problem was the violent fracture of collector tubes, with attendant scattering of glass fragments, under boilout conditions. The data and information generated during the materials analysis segment of this effort are presented. These data were obtained during pressure testing of the individual tubes, performance testing of a complete array of tubes on the MSFC solar simulator apparatus, and in other investigations as noted. The information herein represents only the data directly associated with materials analysis and is not a comprehensive presentation of all the data compiled during the MSFC test program.

5622 (LBL—6974(Rev.)) **Solar test collector for evaluation of both selective and non-selective absorbers.** Lampert, C.M.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 7p. (CONF-780808—17). Dep. NTIS, PC A02/MF A01.

From Meeting of the American Section of the International Solar Energy Society; Denver, CO, USA (28 Aug 1978).

A solar test collector was designed for the testing of thermally absorbing coatings under controlled conditions. The design consisted of a collector fed by a controlled temperature fluid within the range of 25 to 90°C (77 to 194°F). This temperature was maintained by a custom electronic controller. A small variable flow pump circulated water through three collector pipes at selected flow rates. Strip heaters coupled with a differential temperature controller compensated for edge losses associated with small collectors. Detailed design and operation data were presented and three black chrome and one non-selective absorber were analyzed in detail by test collector measurements. Results showed Efficiencies as high as 77% and 75% ($\Delta T = 0$) were obtained respectively for 1.0 μm black chrome on copper and nickel plated steel. The lowest loss coefficients were about 3.8 W/m^2 °C for all black chrome/metal surfaces with the highest being 8.4 W/m^2 °C for the black paint/metal sample.

5623 (SAND—78-0117C) **Concentrator-quality evaluation.** Biggs, F.; Vittitoe, C.N. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 14p. (CONF-780808—2). Dep. NTIS, PC A02/MF A01.

From Meeting of the American Section of the International Solar Energy Society; Denver, CO, USA (28 Aug 1978).

The performance of a reflecting solar concentrator depends, of course, on its surface reflectance, but there are other important factors. Among these are sun-tracking errors, surface-slope errors, and surface irregularities. It is appropriate to use statistics to describe and analyze these non-deterministic factors. A scheme for specifying the quality of a solar concentrator that includes all these effects is described and illustrated. It is believed that this procedure is optimum in the sense that it requires a minimum of measurements to obtain a complete enough description of a concentrator to determine its optical performance under any operating geometry. The specification scheme is, therefore, suitable for use in general systems analysis studies involving solar concentrators.

5624 (SAND—78-8702) **Status report on the direct absorption receiver.** Brumleve, T.D. (Sandia Labs., Livermore, CA (USA)). Jul 1978. Contract EY-76-C-04-0789. 17p. Dep. NTIS, PC A02/MF A01.

A novel receiver concept is described in which concentrated solar energy is absorbed directly in a black, high-temperature, heat transport fluid. Advantages and disadvantages of the method are reviewed, and a summary is presented of the results of investigations on materials stability and corrosion, fluid flow, absorption characteristics, wind effects, and various design studies. Also described are recent high solar flux tests in which levels exceeding 6 MW/m^2 were directly absorbed in the fluid.

5625 **Structural composition and its influence on the optical properties of gold black.** O'Neill, P.; Ignatiev, A.; Doland, C. (Univ. of Houston, TX). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 288-293(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

A model is developed for the optical properties of gold black within the realm of effective medium theory. This model assumes that the strands of gold black can be approximated by spheroids for which the depolarization factor is well known from electrostatic theory. This model is applied to several gold blacks produced by inert-gas evaporation. It is found that excellent agreement between experimental and theoretical transmittance can be achieved in the solar spectrum using a distribution of spheroids (gold black strands) that is closely approximated by a log-normal function. Experimental results for packing factor and sample thickness were used without modification. Experimental data for the electron collision frequency were modified to account for particle size effects.

5626 **Correlation between optical properties and chemical/metallurgical constitution of Cr_2O_3/Cr thin films.** Chang, R.; Hall, W.F. (Rockwell International Corp., Thousand Oaks, CA). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 305-310(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

A theoretical model correlating the optical properties and chemical/metallurgical constitution of Cr_2O_3/Cr thin films for solar thermal applications is outlined. Preliminary results of comparison of calculated and experimental optical properties via the proposed approach are encouraging. It should be possible to synthesize in the computer dielectric/metal composite films of optimum thickness, composition, and composition gradient for the best selectivity in solar thermal applications and to confirm the theoretical prediction by means of directed experimental film processing and property evaluations.

HEAT STORAGE

5627 (CONF-771203—, pp 75-76) **Transient analysis and optimization of an extended surface thermal storage unit which utilizes a phase change material.** Edwards, J.A.; Mody, K.J. (North Carolina State Univ., Raleigh). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5628 (CONF-771203—, pp 221-222) **Solar energy storage via liquid filled cans: tests data and analysis.** Saha, H. (Alabama A and M Univ., Huntsville). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5629 (CONF-771203—, pp 485-487) **Combined water thermal storage: heat exchanger system.** Melroy, P.; Spencer, D.L. (Kirkwood Community Coll., Cedar Rapids, IA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5630 (CONF-780476—1) **Review of current R and D in thermal energy storage and heat exchange in solar applications.** Michaels, A.I. (Argonne National Lab., IL (USA)). [nd]. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From 3. conference on application of solar energy; Huntsville, AL, USA (17 Apr 1978).

A survey of current research and development underway in all of the media and methods used for storing and transferring thermal energy is presented. The thermal energy storage and heat transfer methods discussed are innovative heat exchange and transport, advanced concept sensible heat storage in water, rock, earth or a combination of these, for either short term or for annual storage periods, heat storage in the energy of phase change, and heat storage in the energy of reversible chemical reactions. The material presented is organized in terms of the above categories and subcategories, with the specific R and D projects listed in alphabetical order under the name of the organization conducting the work. The name of the principal investigator is given in each case, together with a literature reference where available.

5631 (COO—4400-7) **Technical status report No. 7, March 15, 1978—May 15, 1978.** (McColl-Wade, Inc., Branford, CT (USA)). 1978. Contract EG-77-A-02-4400. 6p. Dep. NTIS, PC A02/MF A01.

The objective is to develop a commercial demonstration project for an air solar heating and hot water system. Problems and solutions for rock bed storage are reviewed briefly. (MHR)

5632 (ORNL/TM—5758) **Survey of solar thermal energy storage subsystems for thermal/electric applications.** Segaser, C.L. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 101p. Dep. NTIS, PC A06/MF A01.

A survey of the current technology and estimated costs of subsystems for storing the thermal energy produced by solar collectors is presented. The systems considered were capable of producing both electricity and space conditioning for three types of loads: a single-family detached residence, an apartment complex of 100 units, and a city of 30,000 residents, containing both single-family residences and apartments. Collector temperatures will be in four ranges: (1) 100 to 250°F (used for space heating and single-cycle air conditioners and organic Rankine low-temperature turbines); (2) 300 to 400°F (used for dual-cycle air conditioners and low-temperature turbines); (3) 400 to 600°F (using fluids from parabolic trough collectors to run Rankine turbines); (4) 800 to 1000°F (using fluids from heliostats to run closed-cycle gas turbines and steam Rankine turbines). The solar thermal energy subsystems will require from 60 to 36 x 10^5 kWhr (2.05 x 10^5 to 1.23 x 10^{10} Btu) of thermal storage capacity. In addition to sensible heat and latent heat storage materials, several other media were investigated as potential thermal energy storage materials, including the clathrate and semiclathrate hydrates, various metal hydrides, and heat storage based on inorganic chemical reactions.

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 5452

RESOURCE STATUS AND ASSESSMENT

USA

5633 (DOE/ET—0039/1) **Geothermal energy, research, development and demonstration program. Second annual report.** (Department of Energy, Washington, DC (USA). Div. of Geothermal Energy). Apr 1978. 162p. (IGCC—3). Dep. NTIS, PC A08/MF A01.

The discussion is presented under the following section headings: executive summary; national geothermal utilization estimates; Federal Geothermal Energy Program objective; Federal Geothermal Energy strategy; Federal Program planning, implementation, and progress monitoring; organization of the report; national progress and achievements; regional progress and accomplishments; fiscal year 1978 activities; federal program activities in fiscal year 1979 and beyond; Appendix A—interagency coordination and program management Interagency Geothermal Coordinating Council (IGCC); and appendix B—international activities.

5634 (JPL-PUB—77-63) **Analysis of requirements for accelerating the development of geothermal energy resources in California.** Fredrickson, C.D. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Nov 1977. Contract EY-76-A-03-0959. 165p. Dep. NTIS, PC A08/MF A01.

Various resource data are presented showing that geothermal energy has the potential of satisfying a significant part of California's increasing energy needs. General factors slowing the development of geothermal energy in California are discussed and required actions to accelerate its progress are presented. Finally, scenarios for developing the most promising prospect in the state directed at timely online power are given. Specific actions required to realize each of these individual scenarios are identified.

NON-USA

5635 (CONF-771203—, pp 61-63) **Geothermal regions of the USSR and utilisation of their reserves.** Khelkvist, V.G. (All-Union Research Inst. of Complex Energy and Fuel Problems, Moscow); Kononov, V.I.; Andrianov, N.I. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5636 **Broadlands--a gas-dominated geothermal field.** Grant, M.A. (Dep of Sci and Ind Res, Wellington, NZ). *Geothermics;* **6**: No. 1-2, 9-29(1977).

Broadlands geothermal field in New Zealand is a hot-water system containing a few percent of noncondensable gas (carbon dioxide). This small fraction of gas makes the field response markedly different from a conventional hot-water system like Wairakei. The gas pressures cause boiling at depths of about 2 km, so that bores exploit only the two-phase zone. This paper presents a model of response of this subfield to exploitation, and its recovery.

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

5637 **Oscillatory flows in a porous thermoelastic matrix due to earth tides.** Morland, L.W. (Univ of Colo, Boulder). *Geothermics;* **6**: No. 1-2, 107-116(1977).

Vertical motions of a viscous fluid in a permeable elastic or rigid matrix due to a periodic fluctuation in gravity are examined. Isothermal solutions for a deforming matrix, and nonisothermal solutions for a rigid matrix, are obtained for periods over the range of earth tides and for a wide range of physical parameters. It is shown that the fluid pressure variation in each solution has no greater magnitude than the corresponding change due to the same gravity increment in a static situation.

USA

REFER ALSO TO CITATION(S) 5653

5638 (ORO—4891-2) **Geothermal resources, Vicksburg Formation, Texas Gulf Coast.** Loucks, R.G. (Texas Univ., Austin (USA). Bureau of Economic Geology). Jan 1978. Contract EY-76-S-05-4891. 54p. Dep. NTIS, PC A04/MF A01.

The potential for discovering geopressured geothermal reservoirs in the Vicksburg Formation is limited to Hidalgo County along the Lower Texas Gulf Coast. In Hidalgo County, an area of approximately 385 square miles (designated the Vicksburg Fairway) contains up to 1,300 feet of geopressured sandstones with fluid temperatures greater than 300°F. In-place effective permeability, however, averages less than 1 millidarcy in the Vicksburg sandstones because of fine grain size and extensive late carbonate cementation. Also, areal extent of individual reservoirs is limited in a dip direction by growth faults and in a strike direction by the lenticular morphology of the sandstone bodies. In conclusion, under the present specifications set for a geothermal fairway, the Vicksburg has minimal potential because of low reservoir deliverability, which is constrained by low permeability and somewhat limited reservoir continuity. If future tests indicate that lower permeabilities are acceptable, the Vicksburg Fairway should be reconsidered because of the presence of extremely thick sandstone bodies.

5639 (RLO—1014-1) **Mount Hood volcano: phase zero study. Final report, January 1, 1977—June 30 1977.** Hull, D.A. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). 4 Aug 1977. Contract EY-77-S-06-1014. 28p. Dep. NTIS, PC A03/MF A01.

A base of earth science data was developed for an area centered on Mt. Hood Volcano as the first step in a systematic geothermal resource assessment. A comprehensive technical plan for the assessment was developed and is also described. A preliminary bibliography is included.

NON-USA

5640 (CONF-771203—, pp 331-337) **Puchuldiza geothermal field.** Trujillo, P.R. (Comite Geotermico-CORFO, Santiago, Chile). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5641 (CONF-771203—, pp 351-352) **Geothermal systems in the Hauraki rift zone (New Zealand): an example for geothermal systems over an inferred upper mantle swell.** Hochstein, M.P. (Univ. of Auckland, New Zealand). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5642 (CONF-771203—, pp 357-359) **Geothermal energy coupled with solar energy: is the future energy in Saudi Arabia.** Sayigh, A.A.M. (Univ. of Riyadh, Saudi Arabia). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5643 **Stratigraphic and tectonic study of Larderello-Travale basement rocks and its geothermal implications.** Puxeddu, M.; Squarci, P.; Rau, A.; Tongiorgi, M.; Burgassi, P.D. (CNR, Ist Int per le Ric Geoterm, Pisa, Italy). *Geothermics;* **6**: No. 1-2, 83-93(1977).

Exploitation of steam in the Larderello geothermal field (Tuscany, Italy) has caused a decrease in pressure of the feeding layers and a subsequent decrease in production in the most exploited zones. Repeated well tests show that reservoir permeability near wellbottom has remained constant and, therefore, the decreased flowrate is mainly due to the lowering of reservoir pressure. Furthermore, recent studies have shown that the reservoir pressure increases with depth in an exploited vapor-dominated field. Therefore, one objective of geothermal research in intensely exploited areas is that of singling out deep horizons with fluids of a higher enthalpy. The work described here represents first examination of deep features in the Larderello-Travale area to ascertain the presence of productive horizons at greater depths.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 5633

5644 (RLO—1040-2) **Geothermal resource assessment of Mt. Hood volcano, Oregon, Phase I study. Technical progress report No. 2, October 1, 1977—March 31, 1978.** Hull, D.A. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). 31 May 1978. Contract EG-77-C-06-1040. 22p. Dep. NTIS, PC A02/MF A01.

Several phases of the Mt. Hood geothermal resource assessment project are nearing completion. Most of the field work has been completed for the geologic study, gravity survey, and water sampling portions of the project. Thermal modelling, water analyses, rock analyses and age dating, and preparation of a complete Bouguer gravity map are in progress.

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 5640, 5654, 6825

5645 (USGS-OFR—77-66F) **Telluric profile location map and telluric data for the Salt Wells Known Geothermal Resource Area, Nevada.** Hoover, D.B.; Senterfit, R.M.; Fisher, D.; Radtke, B. (Geological Survey, Washington, DC (USA)). 1977. 3p. Geological Survey, Washington, DC.

5646 **Preliminary data of heat flow distribution in Romania.** Veliciu, S.; Cristian, M.; Paraschiv, D.; Visarion, M. (Inst of Geol and Geophys, Bucharest, Rom). *Geothermics;* **6**: No. 1-2, 95-98(1977).

Heat flow values in 21 deep wells in various geological units of Romania were obtained. Some correlations among heat flow within the Moldavian platform (0.92 to 1.39 HFU), the Moesian platform (1.06 to 1.86 HFU) as well as the Carpathian folded chain (1.12 to 2.25 HFU) and structural features of these major units could be established. 12 refs.

5647 **Relationships between terrestrial heat flow and structure of the earth crust in poland.** Rakowska, J.M.; Plewa, S.; Schoeneich, K. (Geol Inst, Warsaw, Pol). *Geothermics;* **6**: No. 1-2, 99-106(1977).

The distribution of the temperature gradients and heat flow are compared with some known parameters of the earth crust in Poland. These geothermal parameters were found to depend on the thickness of the sedimentary cover. The dependence on the depth of Moho discontinuity also exists, but it seems less important. There probably also exists a relationship between thermal anomalies and neotectonics, but because of the scarcity of data these questions still remain open.

5648 **Analysis of the bipole-dipole method of resistivity surveying.** Dey, A.; Morrison, H.F. (Univ of Calif, Berkeley). *Geothermics;* **6**: No. 1-2, 47-81(1977).

Bipole-dipole (B-D) resistivity mapping has been widely used as a reconnaissance method in geothermal exploration. The purpose of this report is to show the response patterns for the bipole-dipole mapping method for more complex buried inhomogeneities. This analysis was effected for the most part using two-dimensional models. A few examples of three-dimensional models are also presented. The effect of depth of burial, source bipole orientation with respect to the strike, overburden layer thickness and conductivity and distance from the transmitting bipole for a single block-shaped conductive target are illustrated.

5649 **Telluric traverse location map and profiles for Fly Ranch, Northeast Known Geothermal Resource Area, Nevada.** Christopherson, K.R.; Hoover, D.B.; Senterfit, M.R. Washington, DC; Geological Survey (1977). 3p. (USGS-OFR—77-66D). Geological Survey, Washington, DC.

5650 **Telluric traverse location map and profiles for Double Hot Springs Known Resource Area, Nevada.** Senterfit, R.M.; Hoover, D.B.; Christopherson, K. Washington, DC; Geological Survey ([nd]). 3p. (USGS-OFR—78-106A). Geological Survey, Washington, DC.

GEOCHEMICAL TECHNIQUES AND SURVEYS

5651 (CONF-771203—, pp 339-345) **Development of the Kizildere Geothermal Field: exploration of a third reservoir and environmental problems.** Esder, T.; Simsek, S. (Mineral Research and Exploration Inst. of Turkey (MTA), Aydin). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5652 **Preliminary evaluation of secondary controls on mercury in soils of geothermal districts.** Klusman, R.W.; Cowling, S.; Culvey, B.; Roberts, C.; Schwab, A.P. (Colo Sch of Mines, Golden). *Geothermics;* **6**: No. 1-2, 1-8(1977).

An evaluation of the mercury concentration in soils of six Colorado geothermal areas is completed utilizing regression analysis. Regression analysis incorporated the secondary effects of pH and the organic carbons, iron, and manganese concentrations on mercury in soils. The technique is used to evaluate a geothermal anomaly at Glenwood Springs, Colorado. The results indicate that secondary influences on mercury in soils of geothermal areas may be of importance in evaluating areas of anomalous mercury leakage.

5653 **Computer storage, processing and display of geothermal data.** Palmer, R.A. (Dep of Sci and Ind Res, Chem, Div, Petone, NZ). *Geothermics;* **6**: No. 1-2, 31-37(1977).

A computer program is described for storing and processing the chemical analyses of steam and water discharges from geothermal fields. Examples of the commands used to control the program are given and some sample output is presented.

5654 **Notes on the chemistry of geothermal gases.** D'Amore, F.; Nuti, S. (CNR, Ist Int per le Ric Geoterm, Pisa, Italy). *Geothermics;* **6**: No. 1-2, 39-45(1977).

This article deals with some chemical reactions that may justify the presence of the more common gas species and their relative abundance in the geothermal fluids (i.e., H_2O, H_2S, NH_3, N_2, CO_2, CH_4). These reactions are used as geothermometers for individuating the deep temperatures in the main ggeothermal reservoir and applied as an example to the Larderello field in Italy. Preliminary results indicate that a "mosaic model" may be used to interpret the behavior of a geothermal system. (14 refs.)

EXPLORATORY DRILLING AND WELL LOGGING

5655 Permeability determination in liquid dominated geothermal reservoirs using the Dual Induction Laterolog. Ershaghi, I.; Dougherty, E.L.; Herzberg, D.; Ucok, H. (Univ. of Southern California, Los Angeles). pp DD1-DD20 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

A method was developed to estimate the permeability profile in a geothermal well from a Dual Induction-Laterolog, a porosity log, and drilling data. The procedure is based on modeling the invasion of the drilling mud filtrate into the formation and using a history matching technique to arrive at the permeability profile. Input data to the computer model includes basic drilling and properties, drilling hydraulics, and dimensions of the tubular goods. A permeability profile is assumed for the well and the computer program is run. The objective is to compare the invasion radius computed from the program to that derived from the logging data. The process is then repeated until a satisfactory match is obtained.

5656 Formation evaluation concepts for geothermal resources. Ehring, T.W. (Aminoil USA, Santa Rosa, CA); Lusk, L.A.; Grubb, J.M.; Johnson, R.B.; DeVries, M.R.; Fertl, W.H. pp FF1-FF14 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

The first successful well logging operation in a 500°F live geothermal steam well was carried out in the Castle Rock Springs Field in northern California on August 6, 1977. At the present time, special high temperature equipment for geothermal wells includes the Gamma Ray/Neutron Log, Compensated Densilog, and Caliper-Temperature Log, run on a special 5/16-inch single conductor cable. The geologic environment of geothermal steam reservoirs is discussed, and several interpretive concepts, such as identification of lithology, determination of reservoir porosity, location of steam entry points, and estimation of steam quality are presented.

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 5633, 5658, 5668

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 5663

GEOTHERMAL POWER PLANTS

POWER PLANT SYSTEMS AND COMPONENTS

5657 (CONF-771203—, pp 347-349) **Pilot facility for the experimental study of binary-cycle conversion systems. Thermogravimetric loop.** Cefaratti, G. (ENEL, Milan); Arosio, S.; Sotgia, G.; Alia, P.; Morandi, G. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5658 (CONF-771203—, pp 57-59) **Economics of upgrading geothermal steam by adiabatic compression.** Valfells, A. (Iowa State Univ., Ames). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5659 (COO—4051-15) **Thermodynamic analysis of geothermal power systems employing separating expanders.** Khalifa, H.E.; Michaelides, E. (Brown Univ., Providence, RI (USA)). 1978. Contract EY-76-S-02-4051. 21p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

A thermodynamic analysis was performed in order to study the possibility of upgrading the thermodynamic performance of a direct-steam geothermal power plant through the use of a separating expander which produces work while achieving effective separation of the two phases. One such device is the Biphase rotary separator. Preliminary testing of this device demonstrated that the isentropic efficiency is about 34% and that the separation efficiency is greater than 99.5%. The analysis indicates that separating expanders can provide a marked thermodynamic improvement over the flash tank arrangement. The analysis shows that even with relatively inefficient separators similar to the prototype tested an improvement of 18 to 21% is possible depending on the initial temperature of the liquid (the improvement is greater for low initial temperature). If the efficiency of the separating expanders can be upgraded from 30% to 50%, single stage systems can produce from 35% (T/sub i/ = 250°C) to 52% (T/sub l/ = 150°C) more work than the equivalent single-flash systems. On the other hand, with the same level of expander efficiency, the two-stage system reflects a 26% advantage over the equivalent dual-flash system. It should be noted, however, that the optimum intermediate temperatures exhibit a pronounced dependence on the efficiency of the expanders. It is also noted that the Biphase device is not the only one that can achieve separation of the phases while producing work. The same functions may be performed by a combination of a total flow expander and a conventional separator. (JGB)

5660 (ICP—1153) **Liquid-fluidized-bed heat exchanger design parameters.** Allen, C.A.; Grimmett, E.S. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office). Apr 1978. Contract EY-76-C-07-1540. 40p. Dep. NTIS, PC A03/MF A01.

Liquid-fluidized-bed heat exchangers prevent scale accumulation on heat transfer surfaces and reduce the required heat transfer surface when scaling fluids, such as geothermal water, are used as the primary or working fluid. Liquid-fluidized-bed heat exchangers, principles of operation, and design parameters are described. Horizontal and vertical assemblies are discussed, including problems encountered with both designs. Bed-side heat transfer coefficients are given for limited cases, and a correlation is provided for calculating heat transfer coefficients for horizontal assemblies. A design example for a 60 kW/sub (e)/ (60 kW/sub (electric)/ preheater is included.

5661 (LBL—7077) **Heat exchanger module test.** Fulton, R.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 4p. (CONF-780641—2). Dep. NTIS, PC A02/MF A01.

From 2. geothermal conference; Taos, NM, USA (20 Jun 1978).

The heat exchanger module test is a cooperative field test of shell-and-tube heat exchangers to be performed with brine from Chevron Resources Company's Heber, California, field. Overall heat transfer coefficients will be measured with isobutane and a mixture of isobutane-isopentane as the working fluid in a simulated power cycle.

5662 (UCRL—52480) **Analysis of a radial-outflow reaction turbine concept for geothermal application.** House, P.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 May 1978. Contract W-7405-ENG-48. 17p. Dep. NTIS, PC A02/MF A01.

The radial-outflow reaction turbine, a pure-reaction turbine designed to improve the conversion efficiency of geothermal energy into electrical power is described. It also has potential as a total-flow turbine for low-temperature water. The principle of incomplete expansion can be used to obtain a reduction in turbine size when the turbine exhausts into a low-pressure condenser. And, by adding this turbine to single- and two-stage flashed-steam systems, the conversion efficiency of systems utilizing low- and high-energy wellhead sources, respectively can be improved. The Appendix outlines the analysis of the radial-outflow reaction turbine and leads to an expression for engine efficiency.

GEOTHERMAL ENGINEERING

5663 (UCRL—81022) **Apparatus for the field evaluation of geothermal effluent injection.** Netherton, R.; Owen, L.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 6p. (CONF-780708—22). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

Methods for evaluating subsurface disposal systems, based on data derived from membrane filtration tests and core flooding experiments, have been described in the literature. These techniques were used to develop and successfully test equipment for evaluation of injectability of any geothermal effluent including hypersaline brine from the Salton Sea Geothermal Field. A schematic diagram of the prototype system for filtration and core flooding is included.

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 5666

5664 (CONF-771203—, pp 67-69) **Thermal fracturing patterns and effects of an imitation hot dry rock by impinging of water jets.** Kiyohashi, H.; Kyo, M.; Ishihama, W. (Tohoku Univ., Sendai). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5665 (LA—7325-MS) **Hot dry rock geothermal energy development project: cablehead assembly. Equipment development report.** Archuleta, J.R.; Todd, B.E. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 120p. Dep. NTIS, PC A06/MF A01.

The development, design, and service history of a multiconductor cablehead capable of operation at 275°C and 103 MPa (15,000 psi) are discussed. This high-temperature cablehead has been in service for about 18 months; conclusions drawn from this test period are summarized.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 5660

5666 (SAN—1308-1) **Geothermal elastomeric materials. Twelve-months progress report, October 1, 1976—September 30, 1977.** Hirasuna, A.R.; Bilyeu, G.D.; Davis, D.L.; Stephens, C.A.; Veal, G.R. (L'Garde, Inc., Newport Beach, CA (USA)). Dec 1977. Contract EG-77-C-03-1308. 98p. Dep. NTIS, PC A05/MF A01.

Progress is reported on efforts to develop elastomers for packer seal element applications which will survive downhole geothermal well chemistry at 260°C (500°F) for 24 hours. To achieve this development, a three level elastomer testing and evaluation program was established. The first level Screening Tests is a broad screening of potential candidates and with the end objective to filter out the more promising candidates for more expensive subsequent testing. The battery of tests include standard ASTM tests and a special test developed to test extrusion resistance using specimens all made from sheet stock. The second level or Simulation Tests provide a laboratory equivalent of downhole conditions using synthetic geothermal fluid. Full scale packer seals are tested under simulated operational conditions by a test fixture. The third level or In-Situ Tests which are currently in the planning, provide for testing the most favored materials in-situ in the geothermal well. A test module provides for testing of the specimen without interfacing with the well casing. A test module freely hanging on a wireline has much lower probability of causing a problem, such as becoming lodged in the well, as compared to an operational casing packer. This maximizes the number of wells (hence geothermal environments) where access can be gained and In-Situ Testing performed. During this period commercially available polymers were investigated. Most of the work centered around formulating peroxide cured Vitons and some on EPDMs, butyls, and resin cured Vitons. Of the formulations tested to date the EPDMs appear most promising and the peroxide cured Vitons next most promising. However, data is too sparse to make any firm conclusions at this time. Minor tasks were performed evaluating current commercially available elastomers used in oil tools and conceptualization of casing packer for the geothermal application.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

REFER ALSO TO CITATION(S) 5664, 5665

5667 **Heat transfer effects in forced geoheat recovery systems.** Hanson, J.M. Corvallis, OR; Oregon State Univ. (1978). 226p. University Microfilms Order No. 78-05,355.

Thesis (Ph. D.).

Current investigations into forced geoheat recovery are based on hydraulic fracturing of impermeable hot dry rock formations. Forced recovery using naturally occurring fluid conductors, viz., fault zones, basaltic dikes, and open formation contacts presents an alternate approach that may circumvent some of the difficulties associated with the hydraulic fracturing method. The latter type of system is considered in terms of the system physical-economic feasibility. The heat transfer surface area required for an economically viable forced recovery system for direct contact heating applications is estimated based on various geologic and economic parameters. The heat transfer surface area reflects the required dimensions of the subsurface system and therefore serves as an indicator of the feasibility of the system. Heat extraction from a hot rock formation based on sheetlike flow involves a balance of the total heat transport of the heat extracting fluid with the conductive heat transport within the rock. The heat recovery efficiency is considered in terms of an idealized flow model in order to estimate the required heat transfer surface area. The results of this work indicate that, under current economic conditions and regional geothermal gradients of 50°C/ km or more, the minimum heat transfer surface area per injection/ production borehole pair required for an economically viable direct-contact heating system with a 10 to 20 year system lifetime is less than 1 km^2. Under the same conditions, it is found that the minimum required heat transfer surface area for electrical power production systems is 2 to 4 times this figure.

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 5539

5668 (BNWL-SA—6554) **Designs for maximum utilization of district heating systems.** McDonald, C.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). [nd]. Contract EY-76-C-06-1830. 8p. (CONF-780109—9). Dep. NTIS, MF A01.

From Technology for energy conservation; Albuquerque, NM, USA (23 Jan 1978).

Portions of document are illegible.

The sensitivities of district heating costs to various design parameters are explored. Some recent studies evaluating the economics of district heating are briefly summarized. The bases and methods for the cost and design sensitivity studies are outlined. Cost and design relationships are examined. These relationships are developed as part of a design study for a city with a population of 175,000. Use of a specific city as a basis for these studies shows the importance of site specific factors in the development of the best district heating design for the city. The problems of utilizing the delivered water are briefly reviewed. Some alternatives system designs are compared in terms of economics, energy efficiency, and their potential for widespread application. (MHR)

5669 (CONF-771203—, pp 65-66) **Exploration of the applicability field of geothermal water fed heat pumps.** De Marchi Desenzani, P.; Giglioli, G. (Istituto di Macchine, Milan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5670 (CONF-771203—, pp 329-330) **Harnessing geothermal energy in Rotorua, New Zealand.** Shannon, R.J. (Ministry of Works and Development, Hamilton, New Zealand). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5671 (CONF-771203—, pp 361-365) **Geothermal community heating systems.** Kunze, J.F.; Stoker, R.C.; Donovan, L.E. (EG and G Idaho, Inc., Idaho Falls). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5672 (SAN—1327-5) **Total Energy Recovery System for Agribusiness: Lake County study. Final report.** Fogleman, S.F.; Fisher, L.A.; Black, A.R. (International Engineering Co., Inc., San Francisco, CA (USA)). Apr 1978. Contract EY-76-C-03-1327. 100p. Dep. NTIS, PC A05/MF A01.

A brief summary is given of the results of a previously reported study designed to evaluate the costs and viability of combined thermodynamic and biologic cycles in a system known as the Total Energy Recovery System for Agribusiness (TERSA). This conceptual system involved the combined geothermally assisted activities of greenhouse crop and mushroom growing, fish farming, and biogas generation in an integrated biologic system such that the waste or by-products of each subsystem cycle were recovered to service input needs of companion cycles. An updated direct use geothermal system based on TERSA that is viable for implementation in Lake County is presented. Particular consideration is given to: location of geothermal resources, availability of land and irrigation quality water, compatibility of the specific direct use geothermal activities with adjacent and local uses. Private interest and opposition, and institutional factors as identified. Factors relevant to local TERSA implementation are discussed, followed by sites considered, selection criteria, site slection, and the modified system resulting.

Particular attention is paid to attempt to make clear the process followed in applying this conceptual design to the specific task of realistic local implementation. Previous publications on geothermal energy and Lake County are referenced where specific details outside the scope of this study may be found. (JGB)

GEOTHERMAL DATA AND THEORY

5673 Establishment of a computer data base on geothermal properties of aqueous NaCl, KCl, and $CaCl_2$ solutions. Fair, J.A.; Phillips, S.L. (Univ. of California, Berkeley). *CODATA Bull.;* No. 23, 15-22(May 1977).

From 5. international CODATA conference; Boulder, CO, USA (Jun 1976).

The objective of GRID (National Geothermal Information Resource) is mainly to compile and disseminate evaluated data on geothermal science and technology. For this purpose, it was found convenient to classify geothermal information into the following six major categories: (1) exploration, (2) utilization, (3) institutional considerations, (4) environmental aspects, (5) reservoir characteristics, and (6) physical chemistry. The major emphasis here is on the physical chemistry category which contains the GRID file on geothermal basic scientific data. For completeness, the data content of the other five categories is also briefly discussed. (MHR)

PROPERTIES OF AQUEOUS SOLUTIONS

REFER ALSO TO CITATION(S) 6337

ROCK-WATER-GAS INTERACTIONS

5674 (LA—7334-MS) **Experimental geothermal loop: I, 295°C study.** Charles, R.W. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

Reaction of granodiorite from the Fenton Hill Hot Dry Rock Geothermal Site with distilled water at 300°C and 345 bars total pressure for 8 months has produced many morphological and chemical effects. Eight polished rock disks were mounted on a tantalum pedestal inside a 500-ml autoclave. The autoclave is part of a circulation system designed for operation to 400°C and 345 bars. Solution samples were taken at 32, 56, 176, 368, 752, 1544, 3104, and 5816 h. Rock disks were removed also at the latter four times. The reactivity of phases was shown to be quartz>>microcline>plagioclase>mafics, opaques, and trace phases. Quartz was removed congruently. The albite component of the plagioclase was dissolved essentially congruently changing plagioclase from oligoclase (fresh) to bytownite (8 mo.). Microcline showed congruent dissolution. Other phases were inert. Secondary mineralization included phillipsite, thomsonite, and vermiculite.

TIDAL POWER

REFER ALSO TO CITATION(S) 5536

WAVE ENERGY CONVERTERS

5675 (CONF-771203—, pp 895-902) **Useful power from ocean waves.** Semo, M. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

WIND ENERGY

REFER ALSO TO CITATION(S) 5536

5676 (HCP/T1617—01) **European wind energy research and recommendations for Hawaii.** Daniels, P.A. (Hawaii Univ., Honolulu (USA)). Aug 1978. Contract EG-77-G-03-1617. 46p. Dep. NTIS, PC A05/MF A01.

The report summarizes impressions of wind power research in Sweden, Denmark and West Germany at the end of 1977. Special emphasis is placed on meteorological aspects. After a list of current wind research activities the following specific areas are treated: numerical model development, wind energy forecasting, visual impact of windmills, statistics for windmill design, windmills in Europe, meteorological instrumentation, wind energy measurement programs and areal assessment of potential wind power. Wind power research which has been going on in Hawaii for several years has encountered much the same problems as those found in Europe. Each section ends with recommendations for Hawaii. Conclusions and a summary of the recommendaqtions complete the report.

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 5441

5677 (CONF-771203—, pp 669-671) **Wind energy assessment.** Hardy, D.M.; Walton, J.J. (Lawrence Livermore Lab., CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

ECONOMICS

REFER ALSO TO CITATION(S) 5682, 5696

ENVIRONMENTAL ASPECTS

5678 (ORNL/ICES—4) **Safety aspects of wind energy conversion systems: a review and bibliography.** James, A.H. Jr. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

The wind energy conversion (WEC) systems that are the products of these efforts are reviewed from the safety viewpoint. Rotor failures, tower integrity, hazards to aviation, and public access to sites are reviewed as public safety considerations. Occupational safety considerations are also reviewed. The conclusions reached indicate that no unusual hazard potential is presented by WEC systems. The bibliography includes articles and reports on various aspects of WEC systems development, design, and operation which relate to safety either directly or indirectly. Reports addressing some of the environmental and legal aspects are also included.

WIND ENERGY ENGINEERING

5679 (CONF-771203—, pp 571-573) **Aeroelastic pump.** Wilson, D.E. (Univ. of South Carolina, Columbia). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5680 (CONF-771203—, pp 577-579) **Clean energy from humid air.** Oliver, T.K.; Groves, W.N.; Gruber, C.L.; Cheung, A. (South Dakota School of Mines and Technology, Rapid City). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5681 (CONF-771203—, pp 677-679) **Energy analysis of a wind energy conversion system for fuel displacement.** Devine, W.D. Jr. (Oak Ridge Associated Universities, TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5682 (CONF-771203—, pp 845-846) **Wind energy conversion systems (WECS) for central station and dispersed power application.** Kornreich, T.R. (JBF Scientific Corp., Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

APPLICATIONS

REFER ALSO TO CITATION(S) 6112

5683 (CONF-771203—, pp 589-591) **Clean energy: some bits and pieces.** Henry, G.E. 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5684 (CONF-771203—, pp 663-665) **Hydrogen from the wind: a clean energy system.** Dubey, M. (Lockheed-California Co., Burbank). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5685 (CONF-771203—, pp 667-668) **Hydrogen fuel production by wind energy conversion.** Ben-Dov, E. (Israel Electric Corp., Ltd. Haifa); Naot, Y.; Rudman, P.S. 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

TURBINE DESIGN AND OPERATION

5686 (CONF-771203—, pp 565-567) **Energy from sea and air by large-span tensioned foils.** Bailey, D.Z. (Bailey Engineering, East Greenwich, RI). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5687 (CONF-771203—, pp 681-682) **Flap-cone control of windmill speed.** Tsai, S.C.; Liu, C.Y.; Tan, T.H.; Tay, S.L. (Univ. of Singapore). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5688 (CONF-771203—, pp 683-690) **Analysis of wind turbine generator rotor response to one-dimensional turbulence.** Frost, W. (Univ. of Tennessee, Tullahoma). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5689 (CONF-771203—, pp 691-694) **Windmills with increased power output due to tipvanes.** van Bussel, G.J.W. (Delft Univ. of Tech., The Netherlands). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5690 (CONF-771203—, pp 695-696) **Axial-flow wind-turbine with delta-wing blades.** Kentfield, J.A.C.; Norrie, D.H. (Univ. of Calgary, Alberta). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5691 (CONF-771203—, pp 799-806) **Toroidal accelerator rotor platforms for wind energy conversion.** Weisbrich, A.L. (Kaman Aerospace Corp., Bloomfield, CT). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5692 (CONF-771203—, pp 841-843) **Review of wind-electric conversion technology.** Ramakumar, R. (Oklahoma State Univ., Stillwater). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5693 (CONF-771203—, pp 847-859) **Feature review of some advanced and innovative design concepts in wind energy conversion systems.** Weisbrick, A.L. (Kaman Aerospace Corp., Bloomfield, CT). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5694 (CONF-771203—, pp 861-862) **Wind system with off-the-shelf components.** Zelby, L.W. (Univ. of Oklahoma, Norman). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5695 (CONF-771203—, pp 863-864) **Campbell Chinese-type windmill.** Campbell, J.S. 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5696 (DOE/NASA/1059—78/1) **Large wind turbine generators.** Thomas, R.L.; Donovon, R.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1978. Contract EG-77-A-29-1059. 36p. (NASA-TM—73767; CONF-780222—8). Dep. NTIS, PC A03/MF A01.
From 5. energy technology conference; Washington, DC, USA (27 Feb 1978).
The Federal Wind Program is reviewed. Descriptions of the Mod-0, Mod-0A, Mod-1, Mod-1A, and Mod-2 wind turbine projects are presented. Power production costs are calculated.

5697 (SAND—78-0014) **Four aerodynamic prediction schemes for vertical-axis wind turbines: a compendium.** Klimas, P.C.; Sheldahl, R.E. (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 18p. Dep. NTIS, PC A02/MF A01.
Four aerodynamic models/design tools used to predict the performance for the vertical-axis wind turbine (VAWT) are described. These models are all based upon the conservation of momentum, and are either currently being used at Sandia Laboratories or have been recently used there. A number of comparisons both with the experiments and between the mathematical treatments is made.

SITE CHARACTERISTICS

5698 (CONF-771203—, pp 673-675) **Wind site selection for optimum wind power systems.** Smith, M.C. (Michigan State Univ., East Lansing). 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

ELECTRIC POWER ENGINEERING

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 5539, 5862, 6038

5699 (CONF-771203—, pp 171-173) **Gas adsorption cycle for electric power generation.** Hartman, T.L. III (Georgia Inst. of Tech., Atlanta); Williams, J.R.; Hartman, T.L. Jr. 1977.
From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).
In Miami international conference on alternative energy sources.

5700 (CONF-771203—, pp 179-181) **Energy cycles: their cost interrelationships for power generation.** Baron, S. Sr. (Burns and Roe, Inc., Oradell, NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5701 (CONF-771203—, pp 193-195) **Potential of alternative energy sources in meeting Air Force requirements.** Barthelemy, R.R.; Hall, D. (Air Force Aero Propulsion Lab., Wright-Patterson Air Force Base, OH). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5702 (CONF-771203—, pp 199-201) **Estimating the commercial potential and energy benefits of ERDA electric energy research.** Park, W.R. (Mitre Corp., McLean, VA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5703 (CONF-771203—, pp 593-594) **Remote new energy sources utilization in on-site non-polluting power plants: liquid air as energy carrier concept and final conversion plant design.** De Marchi Desenzani, P. (Univ., Pavia, Italy); Marchetti, C. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5704 Design problems with regard to boilers for 360-750 MW power units in Poland. Baran, M. (Tech Hochsch, Gliwice, Pol). *Energietechnik;* **28**: No. 1, 16-21(Jan 1978). (In German).

Based on considerations regarding the fuel situation in Poland, the designs, of boilers for 300MW, 500MW, and the future 750 MW power units are described. In particular, problems of the design of fire chambers are discussed. Polish boilers are designed for variable load and for operation under sliding pressure and temperature, as well as for frequent starts and shutdowns.

5705 Computer-based operator guidance system for energy management. Barry, W.J. Jr.; Bell, D.J.; Danforth, H.W. (Continental Forest Industries, Augusta, GA). pp 107-112 of TAPPI conference papers: 1976 engineering. Book 2. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

A computer-based operator guidance system for energy management is presented. Three basic factors that affect the cost to produce energy are discussed. A computer program, which includes mathematical process models, was developed to provide the operator with the necessary information to produce process steam and power at minimum cost.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 6796

5706 Additives for coal. Dixit, S.N.; Cuisia, D.G. *Combustion;* **49**: No. 6, 32-36(Dec 1977).

This paper discusses corrosion and the formation of deposits in coal-fired boilers. Additives are available for slag and deposits control, including both acid neutralizing agents and acid dewpoint depressants; and catalysts are available for improvement of combustion. Using a stack gas sampler and an acid dewpoint meter, the effects of several coal additives were demonstrated in field trials.

POWER CYCLES

5707 (TID—28794) **Assessment of technology for advanced power cycles.** (National Research Council, Washington, DC (USA). Ad Hoc Panel on Advanced Power Cycles). 1977. Contract EX-76-C-01-1216. 168p. Dep. NTIS, PC A09/MF A01.

There was unanimous agreement among Panel members that the highest priority among the advanced power cycles considered should be accorded to the development of advanced gas turbine and steam turbine combined cycles. Accordingly, it is recommended that: 1. The technology required for economically acceptable high-efficiency gas turbine cycles should be developed. Key items requiring attention are cooling and material technology to allow inlet temperatures in excess of 1,370°C on coal-derived fuels and economically acceptable coal-based fuel supply systems—primarily an on-site gasification system integrated into the power system. 2. Pressurized fluidized-bed combustion offers the potential for establishing a direct-fired coal combustion turbine system, and the first priority in this area should be given to identifying the technical and economic feasibility of hot-gas cleanup systems that can meet gas turbine requirements. 3. Molten carbonate fuel cells should be developed sufficiently to permit assessment of economic prospects if possible. 4. Research on open-cycle MHD should proceed at a sufficiently high level to allow selected key experiments to be performed. 5. Energy storage is an important consideration in advanced power systems commercialization since it affects the balance of generating capacities among the base-, intermediate-, and peaking-load categories. 6. Research and development efforts should be focused on the following unit processes and apparatus: Turbine blades and vanes, high-temperature heat exchangers, dirty-gas heat exchangers, hot-gas cleanup systems for particulates and chemical pollutants, an understanding of NO/sub x/ formation in high-pressure combustion, and reliable and economically acceptable low Btu gasifier systems (including gas cleanup and control systems. (LTN)

WASTE-FUELED SYSTEMS

REFER ALSO TO CITATION(S) 5438, 6114

5708 Large bark and wood waste fired boiler: a case history. Nanney, W.M.; Gustafson, F.C. (Wyerhaeuser Co., Longview, WA). pp 19-25 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The development of the project from conception through startup is presented. The approach used to define the objectives, evaluate alternatives, select equipment, and implement the final decision is discussed. The major areas included in the discussion are receiving, storing, and preparing wet and dry wood waste for controlled combustion in a high pressure steam generator; flue gas cleaning, ash disposal, feed water treatment, and electric and steam ties to existing mills.

COMPONENTS

REFER ALSO TO CITATION(S) 5017, 5731, 5732, 5738, 6184

5709 (EPA—600/7-77-073e, pp 79-92) **Statistical considerations important in analyzing measured changes in water-wall tube thickness.** Tukey, J.W. (Bell Labs., Murray Hill, NJ). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

Most measurements of tube thickness are made ultrasonically. Present ultrasonic thickness gauges require calibration. Their calibrations are not much more accurate than their measurements. Statistical analysis of data for significance or confidence requires identification of portions of the data deserving of being treated as having uncorrelated variations/fluctuations/errors. If the practice of calibrating once for each row of measurements on a given wall is followed, the natural portion is a summary—median, mean or rob/res estimate—of the thickness changes found for that row. Estimates of error must then depend on variation from row to row. Using a conventional sum of squared deviations among rows as a basis for significance or confidence can lead to unduly wide allowance for uncertainty, because real trends—say from top to bottom of a wall—are likely. The use of mean square successive differences, introduced more than a century ago by Erastus deForest, and used for eight decades in artillery statistics, can do much to obviate this difficulty. Boilers tend to have two furnaces; furnaces tend to have four waterwalls; observed numbers are such that results for upper/lower half walls often seem interesting. Together or separately, these facts make parallel significance tests or parallel confidence intervals almost inevitable.

5710 (EPA—600/7-77-073e, pp 188-189) **Coal-oil mixture combustion technology.** Foster, C.B. (Department of Energy, Washington, DC). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

A coal-oil mixture combustion program is briefly described that includes utility steam generators, industrial steam generators, and blast furnace injection. The program can be expected to expand to other applications in the future. The objectives of ERDA's program are to modify and retrofit, operate and test existing boilers and blast furnaces, and to design, construct, operate and test proto-

type coal-oil mixture preparation facilities to demonstrate coal-oil mixture technology.

5711 (FE—1806-35) **Development of high temperature turbine subsystem technology to a "technology readiness status". Phase II. Quarterly report, October—December 1977.** Caruvana, A. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Jan 1978. Contract EX-76-C-01-1806. 66p. Dep. NTIS, PC A04/MF A01.

Progress is reported in designing, developing and testing a high-temperature gas turbine for a combined-cycle power plant, using coal-derived fuel at a firing temperature of 2600°F. The design and construction of the Hot Gas Path Development Test Stand and testing plans are detailed. (LCL)

5712 **Stability of turbogenerators of high unit capacity.** Tjudjumow, J. (Komb Kraftwerkdanlagenbau, Berlin, Ger). *Energietechnik;* **28**: No. 1, 13-15(Jan 1978). (In German).

Static and dynamic stability of high-capacity turbogenerators deteriorates owing to an increase in their reactances and reduction of the starting time constant T of a unit. Inertialess excitation systems, combined with PD control, improve the static and dynamic stability of generators.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 6143, 6197, 6282

5713 (CONF-771203—, pp 741-742) **Energy conservation by waste heat utilization.** Lee, S.C. (Univ. of Missouri, Rolla). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5714 (CONF-771203—, pp 743-745) **Waste heat as an alternative energy source.** Karkheck, J.; Powell, J. (Brookhaven National Lab., Upton, NY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

ECONOMICS

5715 (CONF-771203—, pp 369-371) **Dynamic simulation analysis of the effect of peak load pricing on the average price of electrical energy, the capital costs of an electric utility and the profits of an electric utility.** Alexander, S.M. (Univ. of Louisville, KY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 5981, 5982, 6130

FUELS

REFER ALSO TO CITATION(S) 5141, 6174, 6448

5716 (CONF-771203—, pp 175-177) **Wheat straw as a supplemental fuel in utility boilers.** Lester, T.W.; Eckhoff, N.D. (Kansas State Univ., Manhattan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5717 **Practical solutions for converting existing plants to coal.** Kuelske, R.E. Lexington, KY; University of Kentucky (1978). 14p. (CONF-780485—11).

From Industrial coal conference; Lexington, KY, USA (26 Apr 1978).

As early as 1971, two years before the Arab oil embargo, an engineering study was initiated within General Motors to investigate the feasibility and cost of converting all of our large boilers to coal. For the purpose of this paper, large boilers are defined as those having a capacity of 30,000 pounds per hour or more. GM operates more than 350 boilers in this size range in the U.S. A breakdown of the boiler installations by age reveals that a majority of the boilers installed during the past ten years were gas or gas/oil fueled. Most of the gas/oil fueled boilers were small and of the shop assembled or so-called package design. Because of their size and configuration, these units are nearly impossible to convert with conventional technology. During this period, natural gas was being marketed with very little thought for the future. Potential customers were assured that the supply was unlimited. It certainly was convenient and inexpensive. One aspect of the convenience of natural gas that was fully exploited was that it is essentially a pollution free fuel. Gas made it easy to meet stiffening air pollution codes. The business and economic decisions of this period lead directly to the most difficult boiler conversions. A relatively small number of boilers purchased before this period originally were purchased as coal-fired units and subsequently were converted to oil or gas or to a combination of these fuels. In some cases, these boilers can be reconverted with the installation of coal firing equipment and an upgrading of the controls and emission control system. Unfortunately, the coal storage and handling equipment may have been removed to make room for other equipment. Some problems in retrofitting particular boiler installations are discussed in more detail. The possibilities of low Btu gasifiers, coal-fuel oil emulsions and coal liquefaction are discussed briefly. (LTN)

5718 **Estimation of coal quality parameters relevant to the design of power stations.** Simic, M. *Rud. Glas.;* No. 2, 75-79(1977). (In Serbo-Croatian).

This paper describes a new method of determining the values of coal quality parameters which are important in the design and choice of power station boilers. Mathematical models and computer programs have been developed which can be adapted to various geological conditions and to the form and quantity of input data obtained during exploration of the coal deposit concerned.

5719 **Properties of low-ranked coals and their influence on industrial boiler design.** Hensel, R.P.; Skowyra, R.S. (Combustion Engineering, Inc., Windsor, CT). pp 71-80 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The increased use of low-rank coal as a boiler fuel warrants a discussion of the differences between bituminous coals and low rank coals, i.e., sub-bituminous and lignite. Emphasis is placed on ash characteristics and on how these characteristics affect behavior in the boiler, such as slagging in the furnace and deposits on convection surfaces. This is followed by a discussion of how boilers are designed to accommodate various fuel and ash characteristics.

5720 **Coal fired boilers for the paper industry: a case history.** Morris, R.W. (Nekoosa Papers Inc., Ashdown, AK). pp 165-167 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

This paper reviews application studies, the economic justification, the design, construction and operation of a large coal-fired boiler addition to a natural gas fired paper mill power plant. This conception to operation case history pinpoints successes as well as problem areas that may be helpful to others now contemplating the use of coal.

5721 **Coal (lignite): an alternative energy source in the manufacture of pulp and paper products.** Banks, A.J. (Ebasco Services of Canada, Ltd., Toronto). pp 169-179 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

This paper reviews a feasibility study to determine the investment and operation costs associated with the installation of a new lignite fired steam-electric plant to complement the needs of an expanding paper mill. The study also covers equipment design and selection of alternative conceptual designs for the new plant. A comparative plant burning natural gas is reviewed and compared with the lignite-fired installation. The paper addresses itself to the fuel shortage problem which is impacting on almost all the industrial and utility companies in the U.S. which use gas or fuel oil as their basic energy source. The use of coal or lignite and the cost associated with its use may have a major impact on future plant expansion plans. It was found that a much larger investment is required with a lignite-fired electric-steam plant than a gas-fired plant. However, the estimated owning and operating costs for the lignite plant proved to be lower than for the gas fired plant. The higher cost of natural gas over that estimated for lignite was sufficient to overcome the initial investment differential. This conclusion is covered in more detail in the paper.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 5081, 5082, 6796

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 6796

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 5073, 5077, 5078, 5079, 5092, 6440, 6458, 6460, 6562

5722 (CONF-771203—, pp 157-158) **Cost of sulfur removal in electric power generation.** De Rienzo, P.P.; Destefanis, D.; Trapani, C.M. Jr. (Gibbs and Hill, Inc., New York). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5723 (EPA—600/7-77-073c) **Proceedings of the second stationary source combustion symposium. Volume III. Stationary engine, industrial process combustion systems, and advanced processes.** Bowen, J.S.; Hall, R.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab.). Jul 1977. 280p. (CONF-770885—P3). NTIS.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

Seven papers presented at the conference are included in this volume. A separate abstract was prepared for each paper. (LCL)

5724 (EPA—600/7-77-073c, pp 49-106) **Boiler burner design criteria for retrofit with low-Btu gases.** Shoffstall, D.R.; Waibel, R.T. (Institute of Gas Technology, Chicago, IL). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume III.

This research program was initiated to characterize the problems associated with retrofitting existing utility boilers with low-Btu gases manufactured from commercially available coal conversion processes. All the experimental results were gathered from a pilot-scale furnace fired with a movable-vane boiler burner at a rate of 2,250,000 Btu/hr. Low-Btu gases tested ranged in heating value from 300 Btu/SCF to 100 Btu/SCF and were synthetically produced with a natural gas reformer-generating system. Data were collected to permit a comparison between natural gas and low-Btu gases in the areas of flame stability, flame length, flame emissivity, changes in boiler efficiency, and NO/sub x/ emissions. The NO emission data yielded an activation energy of 153 kcal/mol compared to kinetic models which predict 135 kcal/mol. This good agreement suggests that peak temperatures approaching the adiabatic flame temperature are controlling the rate of NO emissions. Thus, the use of the adiabatic flame temperature provides a good empirical method for predicting NO emissions from low-Btu gas combustion.

5725 (EPA—600/7-77-073d, pp 3-38) **Fundamental combustion research applied to pollution control: an overview.** Tyson, T.J.; Heap, M.P. (Energy and Environmental Research Corp., Santa Ana, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

The development of NO/sub x/ control techniques by modification of the combustion process in a timely and cost-effective manner is enhanced if there is a basic understanding of the phenomena associated with NO/sub x/ formation in stationary combustors. This paper describes the initial planning phase of a program designed to synthesize combustion research activities in one subcontractor-oriented program aimed at providing information to develop control techniques. The program addresses two time scales. Information will be generated in the two- to four-year time frame to feed into technology development programs which are essentially directed toward conventional designs. The majority of the effort will be associated with this time scale, however, a non-negligible effort will be expended on more long-term research associated with radical combustor redesign to achieve very low emission levels. The program concentrates upon the generation and control of nitrogen oxides and primary related pollutants produced during the combustion of nitrogen-containing fuels (coal and residual oil) since these are the primary source of nitrogen oxides. The scientific stragegy associated with setting the initial program objectives and the definition of the areas of research to be conducted in-house and by other organizations under subcontract are discussed.

5726 (EPA—600/7-77-073e) **Proceedings of the second stationary source combustion symposium. Volume V. Addendum.** Bowen, J.S.; Hall, R.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab.). Jul 1977. 209p. (CONF-770885—P5). NTIS.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

Eleven papers presented at the meeting are included in this volume. A separate abstract was prepared for each paper. (LCL)

5727 (EPA—600/7-77-073e, pp 65-78) **Design and scale-up of low emission burners for industrial and utility boilers.** Gershman, R.; Heap, M.P.; Tyson, T.J. (Energy and Environmental Research Corp., Santa Ana, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

A research program for developing low NO/sub x/-emission distributive mixing burners for industrial and utility boilers is described. Specific objectives of the study were to design and construct a facility for large-scale burner testing which simulates the geometry and thermal environment of practical boilers; design and build practical low NO/sub x/ burners and test them over a wide range of operating conditions; investigate application of the low NO/sub x/ burner concept to multiburner arrays; and develop scaling laws to assure that the low NO/sub x/ burner concept can be applied to a wide range of furnaces. One burner with a pulverized coal injector was tested, and shows great promise for reducing NO/sub x/ emissions. (LCL)

5728 (EPA—600/7-77-073e, pp 97-106) **Federal regulations.** Farmer, J.R. (Environmental Protection Agency, Research Triangle Park, NC). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

The key provisions of the Clean Air Act which affect stationary sources of combustion are discussed. Primary emphasis is placed on section 111, standards of performance for new stationary sources. The current standards and plans for future standards are also discussed.

5729 (EPA—600/7-77-073e, pp 107-115) **Existing stationary combustion source air pollution regulations.** Duprey, R.L. (Environmental Protection Agency, Chicago). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

Present and proposed air pollution control regulations that affect combustion operations in industrial plants and utility power plants are reviewed. Information is included on the 1970 Clean Air Act Amendments, the 1977 amendments to The Clean Air Act regulations on particulates and sulfur dioxide, and the status of compliance with the regulations. (LCL)

5730 (EPA—600/7-77-073e, pp 145-182) **Evaluation of combustor design concepts for advanced energy conversion systems.** Folsom, B.A.; Corley, T.L.; Lobell, M.H.; Kau, C.J.; Heap, M.P.; Tyson, T.J. (Energy and Environmental Research Corp., Santa Ana, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

The initial tasks in a project designed to assess the effects of combustor design on the control of emissions from advanced power plants burning low Btu gas are reported. Gasification allows coal to be used in an environmentally acceptable manner and when the gasifier is integrated with a combined cycle power plant it also represents an extremely thermally efficient conversion system. It is known that NO/sub x/ formation can be limited by combustion modification techniques. The types of control techniques that might be used are reviewed and the influence of combustor design parameters on cycle performance is assessed.

5731 (EPA—600/7-77-073e, pp 185-187) **Fluidized bed combustion.** Connell, J.M. (Foster-Wheeler Energy Corp., Livingston, NJ). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

The design and operation of a 30 MW fluidized-bed combustion steam power plant built at Rivesville, West Virginia and of a planned 150MW fluidized bed demonstration plant are briefly discussed. (LCL)

5732 (EPA—600/7-77-073e, pp 191-201) **Advanced combined cycles.** Robson, F.L. (United Technologies Research Center, East Hartford, CT). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

Experiments to determine NOx emissions from a combustor fueled by a small gasifier using residual oil, coal or mixtures of the two are described. These tests were performed to evaluate how burner design and fuel-type affect NOx emission which is the major pollutant of interest with combined-cycle power plants operating with fuel gasifiers. The design of a pre-mix combustor is shown. The results show both NOx and SO_2 emissions from gasified coal combined-cycle power plants are below the emissions for conventional steam plants and below proposed air pollution standards. (LCL)

5733 Reduction catalyst for removal of nitrogen oxides in exhaust gas. Tamura, T.; Fujita, N.; Matsuura, C.; Ito, W.; Negishi, N. (to Kogyo Kaihatsu Kenkyusho). US Patent 4,097,576. 27 Jun 1978. Priority date 8 Mar 1975, Japan. 10p.

The catalyst comprises a naturally-occurring inorganic material which is a tuff consisting essentially of SiO_2, Al_2O_3 and H_2O containing 1 to 10% by weight of an alkali metal oxide and an alkaline earth metal oxide. It is produced by depositing the tuff metal ions selected from the group consisting of a metal belonging to Ib Group, IIb Group and VIII Group of Periodic Table, chromium, vanadium and manganese, followed by heat treatment, and repeating the same using different metal ions on each occasion. The catalyst is useful as a reduction catalyst for nitrogen oxides.

5734 Photochemical process for fossil fuel combustion products recovery and utilization. Zenty, S. US Patent 4,097,349. 27 Jun 1978. Filed date 31 Mar 1976. 8p.

Sulfur dioxide (SO_2) and oxides of nitrogen (NO/sub x/) are effectively and economically removed from a gaseous combustion products stream by photochemical conversion of the gaseous SO_2 and NO/sub x/components into particulates (aerosols and mists). The reactive hydrocarbon (RHC) and oxygen deficient fossil fuel combustion products can be converted into a highly photochemically reactive RHC, SO_2, NO/sub x/(NO,NO_2),O_2,H_2O gaseous mixture by the introduction of sufficient quantities of a reactive hydrocarbon, such as an olefin, and oxygen or oxygen containing air. The reactant mixture is then irradiated with electromagnetic waves of the 1,500 A to 7,500 A band of the spectrum, which irradiation is followed by ammonia injection, if desired, to promote particulate formation. The particulate nitrogenous, sulfurous ("nitrates" and "sulfates") and other particulate compounds are removed from the stream by a conventional particulate control system and the products and byproducts can be separated and converted into valuable products of economic value, such as organic and inorganic acids, fertilizers and the like.

5735 Electrostatic precipitator. Kirchhoff, F.J.; Brandt, J. (to Apparatebau Rothemuhle Brandt and Kritzler). US Patent 4,097,252. 27 Jun 1978. Priority date 5 Apr 1975, German, Federal Republic of (F.R. Germany). 4p.

A horizontal-flow electrostatic filter for gas passing from a boiler to a chimney and having separate flow chambers lying horizontally side-by-side has inlet and outlet ducting arranged such that flue gases are divided to flow in opposite directions through the respective chambers, both directions of flow being at right angles to the direction of the shortest distance between the boiler house and the chimney. The flue gas output of the boiler is divided equally between the chambers. The size and hence capacity of the filter may be greater, in this disposition, for a given said distance than if a prior art parallel co-current flow arrangement were used. Capacity for a given available floor space is further assisted by providing a plurality of arrays of collection and discharge electrodes separately electrically supplied and controlled.

5736 Method for removing sulfur dioxide from exhaust gas. Kobayashi, A.; Yaguchi, K.; Takaiwa, M. US Patent 4,092,402. 30 May 1978. Priority date 23 Jun 1975, Japan. 10p.

Scale is formed in a closed system wherein an exhaust gas containing sulfur dioxide is treated with an aqueous solution containing an organic acid alkali salt to remove the sulfur dioxide in the form of gypsum from the exhaust gas. The method disclosed prevents formation of scale in such a closed system.

5737 Status of mechanical collector for coal fired boiler. Mueller, S.P. Lexington, KY; University of Kentucky (1978). 9p. (CONF-780485—9).

From Industrial coal conference; Lexington, KY, USA (26 Apr 1978).

From a technical standpoint, the application of mechanical dust collectors (cyclones) is limited by the maximum efficiency that can be obtained for a given dust analysis, by the minimum temperature at which the collector will operate properly without fouling, and by the capacity of the draft system to overcome the pressure drop through the unit. The three factors then, efficiency required, size analysis, operating temperature and the available static pressure, are the major items, in addition to the volume of gas to be cleaned, which must be known in order to properly apply a mechanical dust collector. The separating performance of a cyclone is dependent upon: Particle mass, tangential velocity and radius of rotation. Thus the separating force is greater with a small radius to travel. Accordingly, higher collection efficiencies are obtainable with smaller diameter cyclones. The shape of the dust is important, particularly as it affects the settling rate. Fly ash particles are not necessarily spherical in shape; many of them are flaky, while others are very jagged. The various physical characteristics that affect settling of dust are incorporated in Stokes Law. The law states that the maximum settling or terminal velocity attained by a dust particle is a function of the square in its diameter, its density, or to be technically correct, the difference in density between the dust particle and the medium in which it is settling. Various methods of determining dust size have been used, such as liquid sedimentation, the Roller Elutriator and the Bahco Micro-Particle Classifier. With a known or predicted dust analysis, a collection efficiency for a commercial dust collector can be calculated. Twelve important points are considered which contribute to the selection and, of course, the success or failure of a proposed mechanical collector application.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 5514, 6097

5738 (EPRI-EL—726(Pt.3)) **Frequency domain analysis of low-frequency oscillations. Part 3. Computer program documentation. Interim report.** Byerly, R.T.; Sherman, D.E.; Bennon, R.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Apr 1978. 120p. Dep. NTIS, PC A06/MF A01.

A small-scale computer program which can be used to determine the natural frequencies and damping of generator rotor oscillations in electric power systems is described. Instructions for data preparation, descriptions of the program, and program listings are included.

5739 Modules for a technical information system for utilities networks. Kern, R.; Weil, W. (Siemens, Erlangen, Ger). *Siemens-Z.;* **52**: No. 4, 259-262(Apr 1978). (In German).

New and efficient means must be made available in order to enable network engineers to meet the demands made by public utilities on data processing for the fulfilment of their technical tasks. The decisive point is to create a technical information system comprising network calculation, line cadaster control and network data base management. The capability of Siemens' BETINA program system to solve such problems is described.

5740 Analysis of operating troubles leading to a gradual loss of operating efficiency. Cheimanoff, A.; Feignier, L.; Gougeuil, J. (Electr de Fr). *Rev. Gen. Electr.;* **87**: No. 3, 191-214(Mar 1978). (In French).

In Part 1 of the article, the mechanisms that precipitate severe troubles in a network are described. It is shown that they are caused by an accumulation of events whose conjunction has a low probability rate and which is therefore not taken in account for the regular safety criteria. Four such mechanisms are generally at the origin of severe disturbances of the system, i.e.: mass load transfers, production losses, deterioration of the voltage level, loss of stability. The circumstances in which such situations may arise and their possible consequences are shown. As an example, the specific case of the mass load transfer is considered. In the second part, the physical phenomena involved in the other procedures described above are outlined and the results of simulations from studies carried out on network operation are quoted.

5741 System reliability calculations in the Sosynaut software system. Dietze, P.; Pritzl, U. (Siemens, Erlangen, Ger). *Siemens-Z.;* **52**: No. 2, 80-84(Feb 1978). (In German).

The system reliability calculation package of the Sosynaut software system for power system automation akes over the following tasks: avoiding of critical switching states, monitoring of the system for weak points, checking of short-circuit breaking capacities and simulation of operating conditions. Descriptions are given of the system configurator, the conditioning of process data and provisions to take account of neighbouring systems.

5742 Improved unitary and multicomponent gaseous insulators. Pace, M.O.; Christophorou, L.G.; James, D.R.; Pai, R.Y.; Mathis, R.A.; Boukdin, D.W. (Oak Ridge National Lab., TN). *IEEE Trans. Electr. Insul.;* **EI-13**: No. 1, 31-36(Feb 1978).

Improved unitary and multicomponent gaseous insulators are systematically designed according to detailed knowledge of fundamental electron-molecule interactions, Knowledge of the electron attachment and electron slowing-down properties of dielectric gases/mixtures as functions of electron energy is shown to be especially significant. On the basis of such knowledge it is possible to improve the gaseous dielectric's breakdown strength by effectively controlling the numbers and energies of the electrons present. Several unitary (e.g. C_4F_6, c-C_4F_8, and iso-C_4F_8) and multicomponent (e.g. $C_4F_6/SF_6/N_2$ and c-$C_4F_8/C_4F_6/SF_6/N_2$) gaseous systems have been tested and found to have better dc breakdown strength properties than SF_6. The findings are reported and discussed.

5743 Optimization procedures for dynamic planning of power transmission systems. Mueller, H.; Thieme, P.; Glimm, O. (Inst fuer Energetik/Zent fuer Ration Energieanwend, Leipzig, E Ger). *Energietechnik;* **28**: No. 1, 9-13(Jan 1978). (In German).

An exact and a simplified optimization procedure for dynamic planning of power transmission networks are described. The exact procedure optimizes all the development stages considered simultaneously. In the case of the simplified procedure, individual development stages are optimized separately and then permissible development sequences are formed. If a sufficient number of individual solutions is used, the precision of the exact procedure is reached.

5744 Detection of breakdown situations in electric power systems. Bogatyrev, L.L. (Polytech Inst im. S.M. Kirova, Sverdlovsk, USSR). *Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk;* No. 3/1, 116-125(1977). (In Russian).

The construction of a classifying hypersurface is considered. In the space of parameters characterizing the conditions of a system and a breakdown situation, it separates classes of stable and unstable operating conditions of an electric power system. The algorithm of determination of the parameters of the resolving hypersurface is based on minimization of the sum of errors of classification of the objects of a learning sample (the set of the operating conditions of a certain classification). The construction of a factor space for detection of breakdown situations is presented. It is based on the method of principal components. Likewise, a resolving rule is constructed, given the presence of logical variables.

5745 Algorithm and program of calculation of steady-state and post-breakdown conditions in complex electric power systems with consideration of frequency changes. Kalyuzhnyi, A.; Sokolov, Yu.V. (Sib Sci Res Inst of Energy, Novosibirsk, USSR). *Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk;* No. 3/1, 126-131(1977). (In Russian).

The algorithm and program presented permit calculation of steady-state operating conditions in a system with active capacities set for all generators and loads without exception. At the same time, the frequency in the system is determined. The moment and velocity characteristics of generators, static characteristics of loads with respect to frequency and voltage, the effect of automatic frequency control protection following frequency decrease, and transverse regulation on transformers are taken into account. The program also permits evaluation of the aperiodic stability of the calculated conditions by means of a strict criterion, namely by the change in the value of the free term of the characteristic equation. The program is envisaged for a BESM-4-type computer.

5746 Algorithms for calculating breakdown operating conditions of incomplete-phase electric power transmission lines by the method of two coordinates. Korolyuk, Yu.F. (Sib Sci Res Inst of Energ, Novosibirsk, USSR). *Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk;* No. 3/1, 146-152(1977). (In Russian).

Such operating conditions of electric power lines are considered, under which the parameters of current elements in direct and reverse-sequence diagrams are mutually equal. Complex equivalent circuits are developed for this case. Calculations with their aid may be carried out on dc and ac models. If the condition z$sub 1$$does not equal$z$sub 2$ is not fulfilled, calculations are carried out in accordance with reduced formulas. An example illustrates how short-circuit currents are determined in both cases.

AC SYSTEMS, EHV AND UHV

5747 Gas insulated electrical high or very high voltage cable. Wanser, G.A.H. (to Gould, Inc.). US Patent 4,092,485. 30 May 1978. Priority date 3 Nov 1975, German, Federal Republic of (F.R. Germany). 4p.

The inner conductor of a gas filled high voltage cable is of composite construction in that a core of alkali-metal, an alloy thereof or two or more alkali-metals, are arranged in a thermoplastic or elastomeric cover which, in turn, is contained in a corrugated metal tube. The outer conductor and spacers are conventional.

5748 Selection of the conductor model length when investigating ehv aerial line insulation. Aleksandrov, G.N.; Podporkin, G.V. (Leningrad Polytech Inst im. M.I. Kalinin, USSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 12, 3-9(Dec 1977). (In Russian).

The electric strength of the air gap between a conductor and the ground depends on the length of the conductor mock-up used in tests. It is shown that, to obtain reliable results, the length of the mock-up must not be less than 100 m. Voltage distribution along the long supporting suspension insulators also depends on the length of the conductor mock-up. Use of short mock-ups results in considerable measurement errors.

5749 Improving the efficacy of wire rope screening of power lines. Goncharik, E.P. (Inst "Energoset'proekt", B SSR). *Izv. Vyssh. Uchebn. Zaved., Energ.;* No. 12, 103-106(Dec 1977). (In Russian).

Results of an investigation of the weakening of the electrostatic effect of EHV aerial power lines by means of grounded screening wire ropes and by supplying voltages to the wire ropes different in phase from the phase voltage of the power line. It is shown that, by means of a rational splitting of wire ropes, it is possible to achieve a screening effect that is close to the suspended one. The optimal design of the wire ropes has to be selected with consideration of the concrete parameters of power lines.

5750 Accounting for the double-layered structure of the dielectric in determining electric field intensity under electric power lines. Zhdanov, I.L.; Kindyakov, V.S.; Lysenko, A.N. (Sib Sci Res Inst of Energ, Novosibirsk, USSR). *Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk;* No. 3/1, 137-140(1977). (In Russian).

The effect of the snow cover on electric field intensity under aerial lines is considered. The electrophysical properties of snow and frozen soil are described. A method of measurement of electric field intensity with and without a snow cover, and also taking frozen soil into account, is presented. It is shown that it is possible to carry out calculations of the field under power lines, in cases where the dielectric has a double-layered structure, by the classical method of mirror-image presentation. Calculations are made on a BESM-6 computer. A satisfactory coincidence between the experimental and calculated data is obtained. It is established that the snow cover increases electric field intensity under power lines. This effect depends on the depth of the snow cover, the class of voltage, and point coordinates. Electric field intensity under a three-phase 750 kV line is calculated taking account of the snow cover.

5751 Insulators for all voltages. Shtern, A.V. *Energoexport;* **4**: 28-31(1977).

A discussion is given of the use of glass insulators for hvac and ehv ac systems power transmission lines. The basic advantages of glass insulators are delineated, and specifications of various types of Soviet glass line insulators are tabulated. (PMA)

DC SYSTEMS

REFER ALSO TO CITATION(S) 5754

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

5752 (BNL—24634) **Properties of plastic tapes for cryogenic power cable insulation.** Muller, A.C. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 27p. (CONF-780751—2). Dep. NTIS, PC A03/MF A01.

From Cryogenic materials conference; Munich, F.R. Germany (10 Jul 1978).

A superconducting ac power transmission cable is under development at Brookhaven National Laboratory (BNL). This project was undertaken in 1972 in response to growing national power requirements. The goal of this program is to develop an underground power transmission system suitable for transferring bulk quantities of electricity over distances of 16 to 160 km. Both the capital investment and operating costs must be low enough to make the system attractive to the electric utilities. The superconducting cable shares the advantages with conventional underground cables of needing only a few feet of right-of-way width rather than the large tracts of increasingly expensive land required for conventional aerial transmission. Recent cost analysis studies show that superconducting cables, although more expensive than aerial transmission, will probably be competitive with other methods of underground transmission at loads greater than 2000 MVA. Initial design studies showed that a flexible, forced-cooled cable offered the best combination of technical and economic features. A helium cooled cable with Nb_3Sn superconductor was chosen as the BNL design. The present goal of the BNL program is the construction of a 100 meter outdoor three-phase ac cable rated at 138 kV and 1000 MVA. The refrigerator and the 100 m-long dewar are already installed. Terminations and cables are under design, and it is planned to begin installation of the

first single phase cable in 1979. If the results on this model show promise for eventual commercial use, cables of higher voltage and power rating will be developed. One fundamental phase of this project; the development of the required insulating materials, is described.

5753 (LA—6953-MS) **50-kA flux pump for the superconducting transmission line test bed.** Wipf, S.L. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 13p. Dep. NTIS, PC A02/MF A01.

A 50-kA, rotating field-type flux pump is suggested as a power supply for the superconducting transmission line test bed. A basic design has been developed as an extension to a previous 12-kA pump. The important design principles are explained. Special emphasis is given to the less-certain aspects of the extrapolation and eight improvements are suggested. The three most important ones are choosing the material for a pump sheet, making the pump sheet out of a specially designed wire cloth, and arranging the return leads adjacent to the pump sheet through the pole gap. Other improvements easily incorporated into the basic design are shading poles, rare earth pole pieces, and superconducting outside windings.

5754 (LA—7442-MS) **Design of a dc superconducting power transmission line using force-free current and magnetic field configurations.** Clem, J.R.; Wipf, S.L. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

A design for a dc superconducting power transmission line, consisting of two concentric cylindrical shells that carry electrical current in force-free configurations, is considered theoretically. The shells are assumed to be composite conductors, containing arrays of thin superconducting filaments in the form of helices centered on the axis of the cylindrical shells. Theoretical expressions are given for the currents and magnetic fields inside and near the shells.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 5539, 6026

5755 (TID—8200-R38) **Nuclear reactors built, being built, or planned in the United States as of June 30, 1978.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Sep 1978. 44p. Dep. NTIS, PC E02/MF E02.

The compilation contains unclassified information about facilities built, being built, or planned in the United States for domestic use or export as of June 30, 1978, which are capable of sustaining a nuclear chain reaction. Information is presented in five parts, each of which is categorized by primary function or purpose.

5756 Operational experience with nuclear power stations in the Federal Republic of Germany. 1977 annual report of the Abe committee in the working party i "engineering and industry" of the German Atom Forum. *At. Strom;* **24**: No. 2, 21-60(Mar-Apr 1978). (In German).

A comprehensive review of operational results in F.R.G. with nuclear power stations during 1977 is presented. Refs.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 5817, 5920, 5947, 5954, 5957, 5959, 5967, 6884

5757 (CDAP-TR—78-033) **Fuel Thermal Expansion (FTHEXP).** Reymann, G.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Jul 1978. Contract EY-76-C-07-1570. 22p. Dep. NTIS, PC A02/MF A01.

A model is presented which deals with dimensional changes in LWR fuel pellets caused by changes in temperature. It is capable of dealing with any combination of UO_2 and PuO_2 in solid, liquid or mixed phase states, and includes expansion due to the solid-liquid phase change. The function FTHEXP models fuel thermal expansion as a function of temperature, fraction of PuO_2, and the fraction of fuel which is molten.

5758 (CONF-771203—, pp 523-525) **Materials for advanced nuclear energy systems.** Steele, L.E. (Naval Research Lab., Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5759 (COO—4066-2) **State-of-the-technology review of fuel-cladding interaction.** Bailey, W.J.; Wilson, C.L.; MacGowan, L.J.; Pankaskie, P.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1977. Contract EY-76-C-02-4066;EY-76-C-06-1830. 122p. (PNL—2488). Dep. NTIS, PC A06/MF A01.

A literature survey and a summarization of postulated fuel-cladding-interaction mechanisms and associated supportive data are reported. The results of that activity are described in the report and include comments on experience with power-ramped fuel, fuel-cladding mechanical interaction, stress-corrosion cracking and fission-product embrittlement, potential remedial actions, fuel-cladding-interaction mechanistic considerations, other ongoing programs, and related patents of interest. An assessment of the candidate fuel concepts to be evaluated as part of this program is provided.

5760 (EPRI-NP—564) **Transient and stability tests at Peach Bottom Atomic Power Station Unit 2 at end of Cycle 2.** Carmichael, L.A.; Niemi, R.O. (General Electric Co., San Jose, CA (USA). Nuclear Energy Engineering Div.). Jun 1978. 176p. Dep. NTIS, PC A09/MF A01.

Turbine trip transient and low flow stability tests were performed at the Peach Bottom-2 BWR/4 nuclear power plant prior to shutdown for refueling at end of Cycle 2 in April 1977. The results of the turbine trip transient tests showed that the fundamental mode of the acoustical pressure oscillation generated in the main steam piping propagates with relatively little attenuation into the reactor core. The magnitude of the neutron flux transient taking place in the BWR core was found to be strongly affected by the initial rate of pressure rise caused by the pressure oscillation. The measured neutron flux transients showed a strong spatial variation along the axis of the reactor core. Very little radial variation in the neutron flux transient was observed. The low-flow stability tests demonstrated that the Peach Bottom-2 Cycle 2 core exhibited a high degree of stability at the limiting test condition above the rated power-flow control line. The measured reactor stability margins showed the expected sensitivity to core power changes at minimum reactor core flow. The tests showed that the small pressure perturbation stability testing offers a useful and practical method of measuring core stability margins. The actual core stability margin was determined from the measured closed-loop pressure to average neutron flux transfer function data based on maximum likelihood estimates of the parameters in a relatively simple transfer function model determined from nonlinear regression analysis. Both static and dynamic error estimates were taken into consideration in evaluating the test results.

5761 (HEDL-SA—1475) **Analysis and extension of the SAND-II code in damage function unfolding applications.** Guthrie, G.L.; Simons, R.L. (Westinghouse Hanford Co., Richland, WA (USA)). [nd]. Contract EY-76-C-14-2170. 6p. (CONF-780722—5). Dep. NTIS, PC A02/MF A01.

From 9. symposium on effects of radiation in structural materials; Richland, WA, USA (10 Jul 1978).

A way has been found to include a-priori information about the expected energy dependence of the damage function (together with uncertainties) as part of the data input of the SAND-II code in damage function unfolding procedures. Damage function analysis is useful when it is necessary to predict property change in a spectrum that is different from the spectra which were used to develop information about the degradation characteristics of the material. If the damage is a non-linear function of fluence, it is sometimes necessary to define an intermediate degradation parameter which is linear in the fluence. The integral equations can then be replaced by a set of linear equations with finite widths for the energy groups and a fixed number of groups. The inclusion of the a-priori information about the damage function causes the linear equations set to be overdetermined. If this overdetermined set is regarded as a least squares problem in log-normal statistics, then a solution can be obtained by a method of steepest descent. The steepest descent solution-algorithm is similar but not identical to the basic algorithm of the SAND-II code. In an overdetermined case, the basic SAND-II algorithm is shown to iterate towards a solution which is identical to the log-normal least squares solution.

5762 (NUREG/CP—0004(Vol.3), pp 1069-1091) **Trends in light water reactor dosimetry programs.** Rahn, F.J. (Electric Power Research Inst., Palo Alto, CA); Serpan, C.Z.; Fabry, A.; McElroy, W.N.; Grundl, J.A.; Debrue, J. 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Dosimetry programs and techniques play an essential role in the continued assurance of the safety and reliability of components

of light water reactors. Primary concern focuses on the neutron irradiation embrittlement of reactor pressure vessels and methods by which the integrity of a pressure vessel can be predicted and monitored throughout its service life. Research in these areas requires a closely coordinated program which integrates the elements of the calculational and material sciences, the development of advanced dosimetric techniques and the use of benchmarks and validation of these methods. The paper reviews the status of the various international efforts in the dosimetry area.

5763 (NUREG/CP—0004(Vol.3), pp 1109-1121) **Determination and evaluation of the mechanical properties of specimens in commercial LWR pressure vessel surveillance programs.** Norris, E.B. (Southwest Research Inst., San Antonio, TX); Perrin, J.S. 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The paper reviews the requirements for a surveillance capsule program including types of mechanical property and neutron dosimetry specimens. Typical facilities used in a hot laboratory for testing specimens are presented. The types of data generated from mechanical property and neutron dosimetry specimens are discussed. In addition, the manner in which the generated data is evaluated and applied to a plant is described.

5764 (NUREG/CP—0004(Vol.3), pp 1123-1139) **Application of advanced irradiation analysis methods to light water reactor pressure vessel test and surveillance programs.** Odette, R. (Univ. of California, Santa Barbara); Dudey, N.; McElroy, W.; Wullaert, R.; Fabry, A. 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Inaccurate characterization and inappropriate application of neutron irradiation exposure variables contribute a substantial amount of uncertainty to embrittlement analysis of light water reactor pressure vessels. Damage analysis involves characterization of the irradiation environment (dosimetry), correlation of test and surveillance metallurgical and dosimetry data, and projection of such data to service conditions. Errors in available test and surveillance dosimetry data are estimated to contribute a factor of approximately 2 to the data scatter. Non-physical (empirical) correlation procedures and the need to extrapolate to the vessel may add further error. Substantial reductions in these uncertainties in future programs can be obtained from a more complete application of available damage analysis tools which have been developed for the fast reactor program. An approach to reducing embrittlement analysis errors is described, and specific examples of potential applications are given. The approach is based on damage analysis techniques validated and calibrated in benchmark environments.

5765 (TREE-NUREG—1204) **Postirradiation examination data report for gap conductance test series. Test GC 2-1.** Murdock, B.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1978. Contract EY-76-C-07-1570. 174p. Dep. NTIS, PC A08/MF A01.

The results of the postirradiation examination of four boiling water reactor type, zircaloy-clad, UO_2-fueled rods tested in the Power Burst Facility are discussed. These rods were employed in Gap Conductance Test GC 2-1 which was performed to obtain experimental data from which test fuel rod gap conductance values could be determined by both the steady state $\int kdT$ and the power oscillation methods. The postirradiation examination results provided in the document will aid in interpreting the experimental data obtained during Test GC 2-1 and in evaluating the effect of fuel behavior on the fuel rod thermal response and interpreted gap conductances. Fuel rod fill gas composition and pressure are discussed. Measurements of fuel pellet-cladding gap and fuel crack areas are presented. The fuel structure is analyzed. Test rod instrumentation and power profiles are examined to better evaluate the test conditions.

5766 **Core design: fuel management as a balance between in-core efficiency and economics.** Robichaud, G.G.; Tulenko, J.S.; Strauss, S.D. (Babcock and Wilcox Co). *Power (N.Y.);* **122**: No. 5, 52-57(May 1978).

After a brief review of the steps involved in the transformation of enriched uranium into the highly engineered fuel assemblies that drive a nuclear reactor, a state-of-the-art survey of fuel-management techniques is given. To optimize the nuclear fuel cycle, the industry is using available fuel-management techniques, such as multibatch shuffling, use of burnable poisons, coast-down, and fuel-assembly reinsertion. In addition, new techniques are under investigation, including designing for a wetter lattice (higher ratio of water to fuel in the core), use of gadolinium as a burnable poison in pressurized-water reactors (PWRs), increasing fuel burnup limits, and designing for minimum use of poison structural material within the core.

5767 **Aspects of layout and problems regarding the construction and engineering of modern nuclear power plants.** Rizzo, F.L. (AMN Impianti per l'Energ, Genova, Italy). *Energ. Nucl. (Milan);* **25**: No. 2, 67-74(Feb 1978).

The engineering aspects of the equipment arrangement inside the building of a nuclear plant, and of the layout of the same, are examined on the basis of the experience mainly acquired during the realization of the Caorso station. Some considerations are then drawn on the difficulties relevant to such a complex project.

5768 **Design, construction and erection of the biological shield wall for the Caorso nuclear power station.** Crucitti, N. (AMN Impianti per l'Energ, Genova, Italy). *Energ. Nucl. (Milan);* **25**: No. 2, 75-84(Feb 1978).

This article describes the major aspects of the design, construction and erection of the biological shield wall encircling the reactor pressure vessel of the Caorso nuclear power station (Italy) (BWR-Mark 2, 840 MWe).

5769 **Radiation effects in boiling water reactor pressure vessel steels.** Kass, J.N.; Giannuzzi, A.J.; Hughes, D.A. (GE, San Jose, Calif). *Am. Soc. Mech. Eng., [Pap.];* No. 78-Mat-11, 1-16(1978).

Effect of neutron irradiation on notch toughness properties of Boiling Water Reactor pressure vessel steels was determined. Samples from several heats of plate, weld metal, and forgivings were irradiated to three different fluence levels and tested. A statistical evaluation of the data was conducted to determine regression analysis mean decreases in upper shelf energy and increases in transition temperature versus fluence.

5770 **Safety evaluation of reactor vessel nozzle cracks.** Riccardella, P.C.; Cooper, W.E. (GE, San Jose, Calif). *Am. Soc. Mech. Eng., [Pap.];* No. 78-PVP-90, 1-5(1978).

Reactor pressure vessels are demonstrated to be highly tolerant to nozzle cracking through Fracture Mechanics analysis, comparison with experiment, and investigation of hypothetical, nonmechanistic failure modes. Comparison with intermediate pressure vessel tests conducted under the Heavy Section Steel Technology program illustrates that nozzle crcking does not reduce the designed-in safety margins of a reactor pressure vessel, when limited in accordance with the ASME Nuclear Inservice Inspection Code (Section XI). Furthermore, in order for such cracks to become critical for rapid propagation, they would have to grow to sizes far in excess of what could conceivably escape detectioin an operating reactor. Thus, it is concluded that nozzle cracking does not decrease the inherent safetry of reactor vessels subject to ASME Code inservice inspection requirements. 6 refs.

5771 **Fracture mechanics analysis of JAERI model pressure vessel test.** Delvin, S.A.; Ricardella, P.C. (GE, San Jose, Calif). *Am. Soc. Mech. Eng., [Pap.];* No. 78-PVP-91, 1-8(1978).

A fracture mechanics evaluation of the Japan Atomic Energy Research Institute (JAERI) model pressure vessel experiment was performed using an analytical method which has been used previously to evaluate Boiling Water Reactor feedwater nozzles. Excellent agreement between analysis and experiment was obtained, from which it is concluded that: the test confirms GE predictions of leak-before-break as the hypothetial failure mode, and the fracture mechanics methodology used by GE to predict nozzle crack growth is accurate for the entire range of crack growth, from nucleation to through-wall leakage. These conclusions are particularly significant with regard to very large cracks (greater than 20 percent of nozzle wall thickness) which have never occurred in an operating reactor, but for which the applicability of the method cannot be demonstrated theoretically. 10 refs.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 5757, 5758, 5759, 5761, 5762, 5763, 5764, 5766, 5770, 5817, 5868, 5920, 5947, 5957, 5958, 5959, 5961, 5962, 5963, 5967, 5972

5772 (CONF-771042—, pp 79-83) **Statistical analysis of reactor core operating limits.** Goldstein, R.; Krisst, R.K. (Combustion Engineering, Windsor, CT). Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

Monitoring and protection systems are included in a modern pressurized water reactor (PWR) to observe the nuclear and thermal characteristics of the reactor core. These systems either alert the operator as core operating limits are approached or initiate a reactor trip before fuel design limits are exceeded. To prevent damage to the nuclear fuel, Combustion Engineering (C-E) specifies fuel design limits on the departure from nucleate boiling ratio (DNBR) and the peak linear heat rate (PLHR) or local power density. Calculational approximations, uncertainties in the design parameters, measurement inaccuracies, and calibration and processing errors all have an effect on the on-line inferred values of DNBR and PLHR. To demonstrate the potential gains in available thermal margin by using a statistical approach, a stochastic simulation of the basic input variables to the Core Protection Calculator in the C-E reactor protection system is carried out. The results obtained from the output distribution for the DNBR uncertainty are compared with corresponding multiplicative estimates ("worst case conditions"). For a typical set of operating conditions, it is specifically demonstrated that the margin to the limit on DNBR is increased by approximately 10.5 percent. Computational efficiency is improved by incorporating concepts of experimental design in the stochastic simulation. In particular, significant variance reduction of the estimator of the mean is achieved by using Latin Hypercube Sampling, as compared to simple random sampling. The root-sum-square expression with sensitivity coefficients is investigated as an estimate of the variance of a composite parameter. For the calculational range of interest, it is found to give a reasonable approximation to the relative standard deviation of the output parameter (DNBR).

5773 (HCP/W4325—01/1) **PWR steam generator chemical cleaning. Phase I: Final report, Volume I.** (Consolidated Edison Co. of New York, Inc., New York (USA)). Jul 1978. Contract EN-77-C-02-4325. 137p. Dep. NTIS, PC A07/MF A01.

Two chemical cleaning solvent systems and two application methods were developed to remove the sludge in nuclear steam generators and to remove the corrosion products in the annuli between the steam generator tubes and the support plates. Laboratory testing plus subsequent pilot testing has demonstrated that, in a reasonable length of time, both solvents are capable of dissolving significant amounts of sludge, and of dissolving tightly packed magnetite in tube/support plate crevices. Further, tests have demonstrated that surface losses of the materials of construction in steam generators can be controlled to acceptable limits for the duration of the required cleaning period. Areas requiring further study and test have been identified, and a preliminary procedure for chemical cleaning nuclear steam generators has been chosen subject to quantification based on additional tests prior to actual in-plant demonstration.

5774 (NUREG/CP—0004(Vol.3), pp 1093-1107) **Characterization of the neutron environment for commercial LWR pressure vessel surveillance programs.** Anderson, S.L. (Westinghouse Electric Corp., Pittsburgh). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The application of both analytical and experimental methods to the determination of the neutron environment internal to a typical Westinghouse PWR is presented. The impact of reactor geometry, core spatial power distributions, and reactor operating history on the neutron environment are discussed; and comparisons of analytical predictions with measurements are presented.

5775 (TFBP-TR—283) **Behavior of defective PWR fuel rods during power ramp and film boiling operation.** Croucher, D.W. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1978. Contract EY-76-C-07-1570. 39p. Dep. NTIS, PC A03/MF A01.

Fuel rods which contained defects representative of defects occasionally found in commercial PWR reactor fuel rods were tested under power ramp and film boiling operation. The results of these tests, part of a larger Nuclear Regulatory Commission program to study the behavior of fuel rods during off-normal operation, are described in the report. The cladding defects included a hydride rupture, a pinhole-type defect, and an axial crack. Operation of defective fuel rods in a power ramp and for a short time in film boiling did not seriously aggravate the condition of the rods beyond that experienced by intact rods undergoing the same transient. Although embrittlement occurred in the cladding in excess of that found in unfailed rods, the defective rods withstood the stresses associated with the quenching of film boiling conditions. Fuel washout occurred where large, open cladding defects were present. No molten fuel-coolant or molten fuel-cladding reactions were observed in the defective rods.

5776 (TID—28760) **Recommendations for Phase 2 acoustic monitoring tests at Indian Point Unit 1.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Water Reactor Divisions). [nd]. Contract EY-76-C-02-2974. 21p. Dep. NTIS, PC A02/MF A01.

A preliminary evaluation of Phase 1 of the acoustic monitoring program at the Indian Point-1 Reactor is presented. Recommendations for achieving specific objectives in leak testing and acoustic emission testing in Phase 2 are presented.

5777 (UNI—78-5087) **PWR steam generator chemical cleaning. Phase I final report. Volume II.** Larrick, A.P.; Paasch, R.A.; Hall, T.M.; Schneidmiller, D. (United Nuclear Industries, Inc., Richland, WA (USA)). May 1978. Contract EN-77-C-02-4325. 325p. Dep. NTIS, MF A01.

Portions of document are illegible.

Consolidated Edison Company of New York has organized and is managing a program for the Department of Energy to develop and demonstrate chemical cleaning methods for removing magnetite corrosion products from the annuli between steam generator tubes and the tube support plates in vertical U-tube steam generators. These corrosion products have caused steam generator tube "denting" and in some cases have caused tube failures and support plate cracking in several PWR generating plants, including Indian Point Unit 2. Under subcontract to Consolidated Edison, United Nuclear Industries conducted laboratory studies to develop a chemical cleaning solvent and application process for demonstration cleaning of the Indian Point Unit 2 steam generators. During December 1977, the chemical cleaning solvent and application process developed were successfully pilot-tested by cleaning the secondary side of one of the Indian Point Unit 1 steam generators. Although the Indian Point Unit 1 steam generators do not have a tube denting problem, the pilot test provided for testing of the solvent and process using much of the same types of equipment and facilities that would be used for the Indian Point Unit 2 demonstration cleaning. The report presents details of the testing programs for both the solvent and the process.

5778 **Three-dimensional versus axisymmetric finite-element analysis of a cylindrical vessel inlet nozzle subject to internal pressure--a comparative study.** Truitt, J.B.; Raju, P.P. (Westinghouse Nucl Energy Syst, Pittsburgh, Pa). *J. Pressure Vessel Technol.;* **100**: No. 2, 134-140(May 1978).

5779 **Pump-induced acoustic pressure distribution in an annular cavity bounded by rigid walls.** Au-Yang, M.K. (Babcock and Wilcox Co, Lynchburg, Va). *Am. Soc. Mech. Eng., [Pap.];* No. 78-PVP-69, 1-8(1978).

This paper describes an analytical method for estimating the coolant pump-induced acoustic pressure distribution in the inlet annulus of a pressurized water reactor. To simplify the problem, flow velocity is ignored and the walls bounding the annular cavity are assumed to be rigid. The phenomenon of beating due to slight differences in the pump blade passing frequencies is included in this analysis. An experiment based on a simple laboratory model is carried out to verify the theory, using small loudspeakers to simulate the pump and air as the fluid medium. Agreement between theory and measurements is good.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 5947, 5953

5780 (GA-A—14646) **Properties of unirradiated graphites PGX, HLM, and 2020 for support and permanent side reflector LHTGR components.** Engle, G.B.; Beavan, L.A. (General Atomic Co., San Diego, CA (USA)). Jun 1978. Contract EY-76-C-03-0167-065. 195p. Dep. NTIS, MFA01.

Portions of document are illegible.

Graphite grades 2020, PGX, and HLM have been evaluated for LHTGR support posts, support floor blocks, and permanent side reflector components, respectively. Data are presented from the first phase characterization of five logs of grade 2020 and two logs each of grades PGX and HLM. The characterization data include bulk density, mechanical properties in tension, flexure and compression, thermal properties, and impurity content. The variations in properties within graphite logs and from log to log are also discussed.

5781 (GA-A—14951) **Oxidation of H-451 graphite by steam. Part I. Reaction kinetics.** Velasquez, C.; Hightower, G.; Burnette, R. (General Atomic Co., San Diego, CA (USA)). Aug 1978. Contract EY-76-C-03-0167-065. 59p. Dep. NTIS, PC A04/MF A01.

The oxidation of H-451 graphite by steam helium mixtures was investigated. The reaction rate constants in the kinetic Langmuir-Hinshelwood equations were calculated. It was found that an apparent transition in the reaction mechanism occurred at about 300 Pa (3000 μatm) H_2O. This was analyzed by calculating two unique

sets of rate constants for two regimes of water vapor pressure. A third, composite set of constants is also submitted which approximately describes the oxidation rate over the entire range of P/sub H_2O/. The composite set is recommended for computer (or other) calculations should the use of two separate sets prove cumbersome. The three sets of reaction rate constants are listed.

5782 (GA-A—15066) **HTGR Generic Technology Program: materials technology reactor; operating experience; medium-enriched-uranium fuel development. Quarterly progress report for the period ending July 31, 1978.** (General Atomic Co., San Diego, CA (USA)). Aug 1978. Contract EY-76-C-03-0167-065. 124p. Dep. NTIS, PC A06/MF A01.

The work reported includes the development of the materials properties data base for noncore components, plant surveillance and testing performed at Fort St. Vrain, and work to demonstrate the feasibility of using medium-enriched fuel in Fort St. Vrain. Studies and analyses plus experimental procedures and results are discussed and data are presented.

5783 (LA-NUREG—6998) **QUIC: a chemical kinetics code for use with the chemical equilibrium code QUIL.** Lunsford, J.L. (Los Alamos Scientific Lab., NM (USA)). Oct 1977. Contract W-7405-ENG-36. 49p. Dep. NTIS, PC E02/MF E02.

A chemical rate kinetics code QUIC is described, along with a support code RATE. QUIC is designed to allow chemical kinetics calculations on a wide variety of chemical environments while operating in the overlay environment of the chemical equilibrium code QUIL. QUIC depends upon a rate-data library called LIBR. This library is maintained by RATE. RATE enters into the library all reactions in a standardized format. The code QUIC, operating in conjunction with QUIL, is interactive and written to be used from a remote terminal, with paging control provided. Plotted output is also available.

5784 (NUREG/CP—0004(Vol.3), pp 1193-1203) **Experimental check of fast neutron dose calculations for high-temperature gas-cooled systems.** Kirch, N.; Drueke, V.; Khamis, M.; Litzow, W.; Neef, R.D. (Kernforschungsanlage, Juelich, Ger.). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

For the pebble-bed-HTGR it is essential to know exactly the fast neutron dose of the graphite reflectors. Due to this value it has to be decided whether the reflectors will stand the whole reactor life-time or whether provisions are to be made to exchange reflector parts with high neutron irradiation damages. Therefore, in the critical facility KAHTER benchmark experiments for estimating fast neutron fluxes and doses were performed. These investigations include an accurate prediction and evaluation of the fast neutron fluxes with the HTGR-computer code system GAMTEREX normalized to the KAHTER-power.

5785 Cesium solubility, diffusion and permeation in zirconium carbide. Stark, W.A. Jr. (Univ of Calif, Los Alamos Sci Lab, NM). *J. Nucl. Mater.;* **73**: No. 2, 169-179(May 1978).

To compare the relative effectiveness of ZrC vis-a-vis SiC as a fission product barrier in fuel structures for high temperature gas cooled reactor (HTGR) applications, a series of cesium infusion experiments on various ZrC powders, and ZrC coated graphite structures was performed. The ZrC powder results yield a solubility of Cs in ZrC, S(ppm wt)=(1.7*10$sup -6$) exp[229 kJ/RT], over the temperature range 1485-1896 K. The diffusion coefficient of Cs in ZrC is 10$sup -18$-10$sup -16$m$sup 2$/s over a similar temperature interval. The activation energy of diffusion is estimated to be $approximately equals$50 kJ/mole. 18 refs.

5786 Fracture toughness of reactor graphite at high temperature. Sato, S.; Awaji, H.; Akuzawa, H. (Univ of Ibaraki, Hitachi, Jpn). *Carbon;* **16**: No. 2, 95-102(1978).

Fracture toughness values increase with increase in temperature. At 2000$degree$C, the values indicate figures about 1.5 times that of the room temperature. From the tensile properties up to 2400$degree$C, the equivalent lengths of cracks and sizes of plastic zones are deduced and discussed in their temperature dependencies. 19 refs.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

5787 (CONF-771203—, pp 501-503) **Breeding with thorium fuel cycles in heavy water moderated reactors.** Banerjee, S. (McMaster Univ., Hamilton, Ont.). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5788 Role of welding in nuclear component fabrications. Srinivasan, M.R. (Power Proj Eng Div, Dep of At Energy, Bombay). *Chem. Age India;* **29**: No. 2, 98-104(Feb 1978).

Examination of the various welding processes used in the fabrication of pressure vessels. These processes include: pulsed MIG welding, pulsed TIG welding and electron beam welding. Also considered are distortion control and weld quality control.

5789 Pre-service and in-service inspection--research and development in support of the canadian nuclear power program. Hodge, R.I.; Wells, N.S.; Licht, H. (At Energy of Can Ltd, Chalk River, Ont). *Am. Soc. Mech. Eng., [Pap.];* No. 78-PVP-23, 1-10(1978).

The Chalk River Nuclear Laboratories are engaged in activities relating to in-service inspection, and in certain instances manufacturing inspection of CANDU (CANada Deuterium Uranium) nuclear power plant components. These activities range from basic research into methods of detecting various property changes in structural material through component and system development to assembly and field test of prototype inspection equipment. This paper reports on CRNL current and recent activities. At the level of development of equipment the authors describe the engineering of a system to eddy-current monitor steam generator tubes (CANSCAN), equipment to survey CANDU zirconium alloy pressure tubes and digital data acquisition systems. Work under current research with future applications are: to improve eddy current and ultrasonic definition of flaws and to improve the matching of ultrasonic transducers to instruments.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 5758, 5766, 5863, 5898, 5899, 5901, 5902, 5903, 5904, 5906, 5908, 5919, 5921, 5922, 5923, 5924, 5925, 5926, 5927, 5928, 5930, 5932, 5933, 5934, 5935, 5936, 5937, 5938, 5940, 5941, 5942, 5943, 5944, 5945, 5946, 5947, 5948, 5949, 5951, 5952, 5965, 5966, 5976, 5979, 6028, 6249, 6250, 6470

5790 (ANL—76-129) **Postirradiation examinations of fuel pins from the GCFR F-1 series of mixed-oxide fuel pins at 5.5 at. % burnup.** Strain, R.V.; Johnson, C.E. (Argonne National Lab., IL (USA)). May 1978. Contract W-31-109-ENG-38. 89p. Dep. NTIS, PC A05/MF A01.

Postirradiation examinations were performed on five fuel pins from the Gas-Cooled Fast-Breeder Reactor F-1 experiment irradiated in EBR-II to a peak burnup of approximately 5.5 at. %. These encapsulated fuel pins were irradiated at peak-power linear ratings from approximately 13 to 15 kW/ft and peak cladding inside diameter temperatures from approximately 625 to 760°C. The maximum diametral change that occurred during irradiation was 0.2% $\Delta D/D_0$. The maximum fuel-cladding chemical interaction depth was 2.6 mils in fuel pin G-1 and 1 mil or less in the other three pins examined destructively. Significant migration of the volatile fission products occurred axially to the fuel-blanket interfaces. Teh postirradiation examination data indicate that fuel melted at the inner surface of the annular fuel pellets in the two highest power rating fuel pins, but little axial movement of fuel occurred.

5791 (ANL-CT—78-39) **Critical heat flux measurements with sodium heating and low water flowrate.** France, D.M.; Chiang, T.; Carlson, R.D.; Minkowycz, W.J.; Priemer, R. (Argonne National Lab., IL (USA)). Jul 1978. Contract W-31-109-ENG-38. 37p. AT.

Seventy critical heat flux (CHF) experiments were performed in the Steam Generator Test Facility (SGTF) employing a straight vertical steam tube of 13.1 m length, 10 mm inside diameter, heated by flowing sodium. The water mass flux was relatively low ranging from 0.1 to 0.6 $Mg/m^2.s$, and the majority of the data were obtained at a water pressure of 7.3 MPa. The data are presented in measured and reduced form for each test. The critical quality and thermal stress in the tube wall at CHF are compared to extrapolations of previously derived empirical correlation equations.

5792 (CONF-771203—, pp 113-115) **LMFBR: logic and technology.** Little, W.W. (Hanford Engineering Development Lab., Richland, WA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5793 (CONF-771203—, pp 117-119) **Meeting U.S. electrical needs: is the breeder urgent.** Osborne, T.C. (General Electric Co., Sunnyvale, CA); Palmer, R.S.; Wyckoff, H.L. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5794 (CONF-771203—, pp 121-122) **Role of the breeder reactor in our energy future.** Rop, D.J. (Westinghouse Electric Corp., Madison, PA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5795 (CONF-771203—, pp 127-129) **Thermal analysis of a variable geometry multi-region nuclear fuel rod.** Almond, M.D.; Wolf, H. (Univ. of Arkansas, Fayetteville). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5796 (CONF-771203—, pp 131-133) **EBR-II experience on fission-product release from sodium-bonded fuel elements.** So, B.Y.C.; Lambert, J.D.B. (Argonne National Lab., IL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5797 (CONF-771203—, pp 491-495) **Alternative fuel cycles for breeder reactors.** Burns, T.J. (Oak Ridge National Lab., TN); Bartine, D.E.; White, J.R.; Kallfelz, J.M.; Rowland, D.M. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5798 (CONF-771203—, pp 497-499) **Use of ^{232}Th—^{233}U fuel cycle in fast breeder reactors.** Horak, J.A.; Lotts, A.L. (Oak Ridge National Lab., TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5799 (CONF-771203—, pp 505-507) **Low proliferation risk breeder reactor fuel cycles.** Goldstein, M. (Brookhaven National Lab., Upton, NY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5800 (CONF-771203—, pp 513-515) **Gas core reactor: an alternative to existing reactor concepts.** Schnitzler, B.G.; Schneider, R.T. (Univ. of Florida, Gainesville). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5801 (CONF-771203—, pp 601) **Road to energy independence: the breeder reactor.** Anderson, J.C. (Oak Ridge Associated Universities, TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5802 (CONF-780203—9) **U.S. program for large sodium/water reaction tests.** Whipple, J.C.; Amos, J.C.; DeBear, W.S.; Neely, H.H.; Hopenfeld, J. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). [nd]. Contract EY-76-C-03-0189; EY-76-C-03-0701. 26p. Dep. NTIS, PC A03/MF A01.

From 1. joint U.S./Japan LMFBR steam generator seminar; Tokyo, Japan (13 Feb 1978).

An extensive large leak test program is underway in the United States to investigate the effects of large sodium-water reaction events in LMFBR steam generators. The general objectives of the program are to provide data for validating analytical codes, provide information on the extent of secondary tube failures, provide data on relief system performance and provide data on cleanup and recovery needs. Tests are conducted in the Large Leak Test Rig located at the Liquid Metal Engineering Center. The program is divided into two phases, Series I and Series II, for the purpose of satisfying near-term and long-term needs. The Series I testing, utilizing the Atomics International modular steam generator as the test article, commenced in July 1976 with six tests completed by November 1977. The test article for the Series II tests (the Large Leak Test Vessel/Large Leak Test Internals) has been fabricated. Upon completion of Large Leak Test Rig modification, test article installation, and system checkout Series II testing will begin in the Spring of 1979. The overall program plan is defined, the test articles and test facility are described, and the experimental approach is discussed for both Series I and II programs. The Series I test experience and results of intertest examinations are also presented.

5803 (CRBRP-GEFR—00323) **Analysis of ZPPR-6 critical experiments.** Lee, B.W.; Stewart, S.L. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Jan 1978. Contract EY-76-C-15-2395. 143p. AT.

This report presents analysis of critical experiments performed in the Zero Power Plutonium Reactor (ZPPR) in support of the Clinch River Breeder Reactor Project (CRBRP) initial core critical, power distribution, and neutron and gamma flux distribution. The major emphasis is on analysis of the CRBRP Engineering Mockup Critical (EMC) Experiment Phase 2A also identified as ZPPR Assembly 6.

5804 (GA-A—15054) **Gas-cooled fast breeder reactor. Quarterly progress report, May 1, 1978—July 31, 1978.** (General Atomic Co., San Diego, CA (USA)). Aug 1978. Contract EY-76-C-03-0167-023. 352p. Dep. NTIS, PC A16/MF A01.

Progress is summarized in development of GCFR fuel, blanket, and control assemblies; development of the pressure equalization system for GCFR fuel; out-of-pile loop facility test programs; fuels and materials development; fuel, blanket, and control rod analyses and development; nuclear analysis and reactor physics for GCFR core design; shielding requirements for the GCFR; reactor engineering to assess the thermal, hydraulic, and structural performance of the core and the core support structure; plant systems control; systems engineering; development of reactor components, including reactor vessel, control and locking mechanisms, fuel handling equipment, core support structure, shielding assemblies, main helium circulator, steam generator, circulator test facility, and auxiliary circulator; development of a helium circulator test facility; reactor safety, environment, and risk analyses, including planning and support of an in-pile and out-of-pile safety test program; nuclear island engineering design; and development of a reliability data bank.

5805 (GEFR—00352) **Microleak wastage test results.** Gudahl, J.A.; Magee, P.M. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Mar 1978. Contract EY-76-C-03-0893-030. 83p. AT.

The report presents results of, and conclusions drawn from, the microdefect self-wastage tests conducted on 2-¼Cr-1Mo tubing samples in the new sodium filled Crackpot facilities. A total of fifteen sodium-water reaction tests were run at three temperature levels:580°F (304°C), 650°F (343°C) and 900°F (428°C). In seven tests, complete self-wastage penetration of the tube wall occurred under constant temperature conditions. In three tests at 580°F and one at 650°F, the leak rate remained below the initial leak rate during the entire test. Four tests at 650°F plugged completely and remained plugged for the duration of the tests, in three cases for more than two months. These three plugged specimens were then thermally cycled; only one reopened. All steam leaks (650°F and 900°F) initially less than 10^{-5} lb/sec (4.5×10^{-3} gm/sec) completely plugged for at least some period of testing. Conversely, only one leak initially greater than 10^{-5} lb/sec decreased as much as one decade in leak rate. Water leaks (580°F) showed less tendency to plug and, if plugging occurred, greater tendency to reopen than the steam leaks, although the latter were at higher temperatures. It was determined that the enlargement growth rate is slow enough at 580 to 650°F that the CRBRP evaporator tubesheet regions are fully protected against microdefects initially so small as to be undetectable by the chemical leak detection system. However, because self-wastage damage rates are considerably faster at higher temperatures, there is a significantly probability that growth of an initially undetectable microleak in a CRBRP superheater will result in impingement wastage damage and possible failure of adjacent tubes bfore leak detection and unit shutdown.

5806 (GEFR—00367) **Microstructural results from F20 power-to-melt experiment.** McCarthy, W.H.; Jedlovec, D.R. (General Elec-

tric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). May 1978. Contract EY-76-C-02-0893-031. 172p. AT.

Data are provided on operating conditions, plenum gas, retained gas, and 113 microstructural specimens obtained from the GE-F20 power-to-melt experiment. The report extends the range of fuel and irradiation parameters that were contained in earlier reports on F20 Experiment results.

5807 (GEFR—00369) **Gas Cooled Fast Reactor (GCFR) core support design review.** Hackford, N.E.; McCarty, L.H. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Jun 1978. Contract EN-77-C-03-1435. 64p. Dep. NTIS, PC A04/MF A01.

The GCFR core support design appears to be a sturdy structure that will readily withstand primary loads. The relative stiffness of the GCFR grid plate support structure should minimize seismic effects on the structure. The grid plate itself appears strong enough to limit core reactivity effects from plate distortion. Thermal insulation thickness may be relatively thin, on the grid plate support structure outer surface, without causing excessive thermal gradients. The primary concern is how to attach the insulation to prevent gas leakage between the insulation and structure that may limit reactor life. Although entirely feasible, this is an important concern, that could result in undesirable temperature gradients in the structure. The design and development activities appear to have effectively addressed many of the primary concerns with this core support concept. Grid plate deformation from coolant flow differential pressure (42 psid) was calculated to assess core reactivity effects of a sudden reduction of this pressure differential. In addition, the concern with shielding the grid plate from the detrimental effects of neutron irradiation has received careful attention. These concerns that directly affect the concept feasibility were recognized early and have received primary attention. The review identifies many advantageous features of the GCFR core support structure, and they are listed throughout the text of the report. In addition, potential design improvement areas and development suggestions have been identified. These development areas and design concerns have been specifically identified for consideration as potential improvements to the GCFR core support.

5808 (GEFR-SP—044) **Selection of the design basis leak for LMFBR steam generators.** Meyer, R.A.; Pfefferlen, H.C.; Roberts, J.M.; Sane, J.O. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Nov 1977. Contract EY-76-C-03-0893. 17p. (CONF-780203—2). Dep. NTIS, PC A02/MF A01.

From 1. joint U.S./Japan LMFBR steam generator seminar; Tokyo, Japan (13 Feb 1978).

Steam generator tube failure mechanisms that have been observed in experiments or that have been postulated are discussed. The DBL for CRBRP and a proposed DBL for future large LMFBR steam generators are described. Safety considerations and philosophy in selection of Design Basis Leaks (DBL) are presented. A discussion of the Large Leak Test Rig (LLTR) Series II program support of the DBL selection for future large LMFBR steam generators is included.

5809 (HEDL-SA—1429FP) **Summary of sodium removal and decontamination programs in the U.S.A.** Steele, O.P. III; Brehm, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1978. Contract EY-76-C-14-2170. 8p. (CONF-780232—3). Dep. NTIS, PC A02/MF A01.

From IAEA meeting on sodium removal and decontamination; Richland, WA, USA (14 Feb 1978).

The goals of the United States Department of Energy sodium removal and decontamination programs are (1) to identify plant requirements and develop safe effective processes for sodium removal, both for experimental facilities and for reactor components, (2) to develop effective decontamination processes for removing deposited radioactivity, (3) to establish and put into use a set of workable criteria for requalification and return to service of components after sodium removal and decontamination, (4) to design, build and operate facilities in which to perform the sodium removal and decontamination operations. The paper gives a summary of progress toward each of these goals. Three basic processes for sodium removal have been investigated extensively: the use of water vapor in an inert carrier gas, the use of alcohol-type reagent, and evaporation. The process development work on the first two processes has been essentially completed. The evaporative process is still under development, but preliminary parameters have been established.

5810 (HEDL-SA—1447-S) **Fuel column stability in irradiated mixed-oxide fuel.** Melde, G.F.; Weber, J.W.; Dutt, D.S. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1978. Contract EY-76-C-14-2170. 7p. (CONF-780622—58). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

The dimensional stability of the fuel columns of 250 mixed uranium—plutonium—oxide fuel pins irradiated in EBR-II was evaluated including length and fuel-to-cladding gap size changes. Fuels with spherical porosity and fuel with nonspherical porosity were included in the study. Sufficient insight into the basic processes responsible for fuel behavior has been gained from this study to allow evaluation of expected behavior of fuel in advance of irradiation. All evidence indicates that mixed-oxide fuel columns for fast reactor applications are dimensionally stable and should present no problem to reactor operations.

5811 (HEDL-SA—1452) **Characterization of corrosion product deposits in sodium systems.** Colburn, R.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1978. Contract EY-76-C-14-2170. 17p. (CONF-780232—4). Dep. NTIS, PC A02/MF A01.

From IAEA meeting on sodium removal and decontamination; Richland, WA, USA (14 Feb 1978).

Portions of document are illegible.

The characterization of mass transfer deposits on the containment surface of sodium systems is an essential step in the development of LMFBR decontamination processes. The surfaces of a sodium test facility used to study radioactive mass transport were examined to determine the chemical and physical nature of the deposits. The examination showed two fundamentally different problems will occur in the hot and cold leg regions of an LMFBR heat transport system. In the hot leg ^{60}Co, ^{58}Co and ^{54}Mn will diffuse into the base metal and decontamination may require the removal of several microns of the base metal. In the cold leg ^{54}Mn will be the dominant radionuclide. It will be largely incorporated in nickel-manganese rich particles, a few microns in diameter, scattered on the surface as a semiadherent deposit with very shallow penetration into the base metal. For this region a process should be developed which selectively attacks the deposit phase with minimal attack on the base metal.

5812 (HEDL-TC—1022) **Natural circulation heat transfer testing with a simulated full-scale LMFBR 217-pin electrically heated fuel assembly: test data.** Millburg, M.L.; Hassberger, J.A.; Boasso, C.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1978. Contract EY-76-C-14-2170. 240p. AT.

The heat transfer characteristics of a Clinch River Breeder Reactor Plant (CRBRP) nearly prototypic fuel assembly in a liquid sodium environment were investigated under low flow conditions indicative of natural circulation. The facilities, test plan and tests themselves were described in detail and discussed in an earlier report, "Natural Circulation Heat Transfer Testing with a Simulated Full-Scale LMFBR 217-Pin Electrically Heated Fuel Assembly", HEDL-TME 77-3, June 1977. The report presented provides the data obtained during the test activities. These data were developed to supplement analytical predictions of assembly heat transfer and flow redistribution within this range of reactor operation.

5813 (HEDL-TME—78-38) **National friction, wear, and self-welding program status and plans.** Johnson, R.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1978. Contract EY-76-C-14-2170. 92p. AT.

The report documents the status and plans of the National Friction, Wear, and Self-Welding Program. The primary objective of this program is to qualify materials for tribological applications through selection, development, and testing activities. The long-term goal is to develop a base list of well-characterized, wear-resistant materials, practical and economical fabrication process, and qualified sources of supply. The report reviews the status of testing and development activities, identifies program needs, and recommends courses of action and priorities for future testing and development.

5814 (HEDL-TME—78-57) **User's manual heatup closed cell H and V failure transient analysis code.** Chandler, J.C. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1978. Contract EY-76-C-14-2170. 128p. Dep. NTIS, MF A01.

Portions of document are illegible.

HEATUP, a closed cell cooling system failure transient analysis code for Liquid Metal Fast Breeder Reactor (LMFBR) licensing analyses is described. The code replaces a modified version of SOFIRE-II formerly used for cooling failure analyses on the Fast Flux Test Facility (FFTF). HEATUP calculates heat transfer rates within the cell structure and produces temperature and pressure histories based on input-controlled process sodium conditions. The output is designed to be readily usable for emergency load sequencing and structural analyses.

5815 (HEDL-TME—78-66) **Analysis of fuel-cladding chemical interaction in mixed-oxide fuel at high burnup.** Lawrence, L.A.; Weber, J.W.; Devary, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1978. Contract EY-76-C-14-2170. 52p. Dep. NTIS, PC A04/MF A01.

The character and extent of fuel-cladding chemical interaction (FCCI) were established for mixed uranium-plutonium oxide fuels at an initial oxygen-to-metal ratio of 1.984 irradiated in EBR-II to a peak burnup of approximately 90.0 MWd/kgM. Depths of interaction were correlated with fuel pin operating conditions, i.e., burnup and temperature, and results discussed in terms of a change in reaction kinetics.

5816 (IWGFR—13-1) **Profiles of facilities used for FRB research and testing. Supplement 1.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fast Reactors). Mar 1978. 79p. Dep. NTIS, PC A05/MF A01.

The document contains a concise up-to-date description of French supporting LMFBR facilities which were not included in "Profiles of Facilities Used for FBR Research and Testing" reproduced and distributed by the IAEA in December 1976.

5817 (NUREG/CP—0004(Vol.3), pp 1141-1175) **Status report on dosimetry benchmark neutron field development, characterization, and application.** Fabry, A. (SCK/CEN, Mol, Belgium); Grundl, J.A.; McElroy, W.N.; Lippincott, E.P.; Farrar, H. IV. 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The report attempts to present a brief, but comprehensive review of the status and future directions of benchmark neutron field development, characterization and application in perspective with two major objectives of reactor dosimetry: (1) fuel fission rate and burn-up passive monitoring, and (2) correlation of materials irradiation damage effects and projection to commercial power plants. The report focuses on the Light Water Reactor and Fast Breeder Reactor program needs.

5818 (NUREG/CP—0004(Vol.3), pp 1267-1278) **Fast reactor fission yield measurement program at the Idaho National Engineering Laboratory.** Maeck, W.J.; Emel, W.A.; Delmore, J.E. (Allied Chemical Corp., Idaho Falls, ID). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The INEL fission yield measurement program and the current status of the results are reviewed. Fast reactor fission yields for ^{233}U, ^{235}U, ^{238}U, ^{239}Pu, ^{241}Pu, and ^{237}Np obtained for samples irradiated in Row-8 of EBR-II have been reported. The neutron spectrum associated with the reported yields has been reported. Measurement of fast reactor fission yields for ^{240}Pu, ^{242}Pu, and ^{241}Am is in progress. To supplement these data, and to provide additional correlation points relative to the effect of neutron energy on fission yields, a series of samples previously irradiated in the axial blanket and Row-2 to 4 of EBR-II has been obtained for analysis. Future efforts relative to recommending and prooftesting methods for the analysis of burnup for FBR fuels are discussed.

5819 (NUREG/CP—0004(Vol.3), pp 1279-1287) **Studies relative to the correlation of fission yields with neutron energy.** Maeck, W.J. (Allied Chemical Corp., Idaho Falls, ID). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The status of fission yield data is briefly reviewed. Problems associated with the evaluation and compilation of fast reactor fission yields are discussed. A new approach for evaluating the change in fission yields with neutron energy is presented. Based on a comparison of relative isotopic abundances rather than absolute yield data, changes of only a few percent in the isotopic abundances of the neodymium isotopes as a function of neutron energy are easily detected.

5820 (NUREG/CP—0004(Vol.3), pp 1289-1306) **Reference and standard benchmark field consensus fission yields for U.S. reactor dosimetry programs.** Gilliam, D.M. (National Bureau of Standards, Washington, DC); Helmer, R.G.; Greenwood, R.C.; Rogers, J.W.; Heinrich, R.R.; Popek, R.J.; Kellogg, L.S.; Lippincott, E.P.; Hansen, G.E.; Zimmer, W.H. 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Measured fission product yields are reported for three benchmark neutron fields—the BIG-10 fast critical assembly at Los Alamos, the CFRMF fast neutron cavity at INEL, and the thermal column of the NBS Research Reactor. These measurements were carried out by participants in the Interlaboratory LMFBR Reaction Rates (ILRR) program. Fission product generation rates were determined by post-irradiation analysis of gamma-ray emission from fission activation foils. The gamma counting was performed by Ge(Li) spectrometry at INEL, ANL, and HEDL; the sample sent to INEL was also analyzed by NaI(Tl) spectrometry for Ba-140 content. The fission rates were determined by means of the NBS Double Fission Ionization Chamber using thin deposits of each of the fissionable isotopes. Four fissionable isotopes were included in the fast neutron field measurements; these were U-235, U-238, Pu-239, and Np-237. Only U-235 was included in the thermal neutron yield measurements. For the fast neutron fields, consensus yields were determined for three fission product isotopes—Zr-95, Ru-103, and Ba-140. For these fission product isotopes, a separately activated foil was analyzed by each of the three gamma counting laboratories. The experimental standard deviation of the three independent results was typically +- 1.5%. For the thermal neutron field, a consensus value for the Cs-137 yield was also obtained. Subsidiary fission yields are also reported for other isotopes which were studied less intensively (usually by only one of the participating laboratories). Comparisons with EBR-II fast reactor yields from destructive analysis and with ENDF/B recommended values are given.

5821 (NUREG/CP—0004(Vol.3), pp 1307-1321) **EDB-II validated, key fission product yields for fast reactor application.** Kellogg, L.S.; Davis, A.I.; Lippincott, E.P.; Ruggles, J.M. (Hanford Engineering Development Lab., Richland, WA). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Relative fission yields were measured for three different locations in the row 4 "Test Region" of the EBR-II reactor. Correlation of the relative fission yields to the measured average energy (anti E) and the measured ^{137}Cs $^{238}U/^{235}U$ spectral indices have been made. The measured relative fission yields for selected fission products from ^{235}U, ^{238}U, ^{239}Pu and ^{237}Np have been compared with those values reported by the Interlaboratory Reaction Rate (ILRR) program, EBR-II fast reactor yields from destructive analysis and summation, and the March 1977 version of ENDF/B-V.

5822 (ORNL—5258) **Results from irradiation of vented GCFR fuel rods in the GB-9 and GB-10 capsule experiments.** Longest, A.W.; Conlin, J.A. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 220p. Dep. NTIS, PC A10/MF A01.

Two gas-cooled fast breeder reactor (GCFR) vented-and-pressure-equalized fuel rods were tested in the GB-9 and GB-10 instrumented thermal-flux capsule experiments at Oak Ridge National Laboratory (ORNL) in support of fuel development for the GCFR. The experiments were designed to yield basic information on the fission-product release and transport behavior and general rod performance to be expected in the reference GCFR vented-element system. The report describes the design and presents the results obtained from each of these closely related experiments. A discussion of the known uncertainties in the data of both experiments is included so that the information may be applied in the GCFR and other applications.

5823 (ORNL/TM—6309) **Preliminary neutronic study of actinide transmutation in a fast reactor.** Williams, M.L.; McAdoo, J.W.; Flanagan, G.F. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

Preliminary results are cited from a neutronic study of actinide recycle in a fast reactor, using an LMFBR model. The work was performed as part of a Chemical Technology Division program for assessing the merit of actinide transmutation as a means of waste disposal. Calculations were performed by coupling two-dimensional diffusion theory calculations with point-depletion recycle calculations. Cross sections were obtained from a "preliminary" version of ENDF/B-V. Results are given concerning the recycled-actinide equilibrium condition and the waste-actinide destruction rate. The effect of adding U-238 diluent to reduce power peaking is examined parametrically. The heterogeneous effects of placing an actinide target assembly in a fuel lattice are also examined.

5824 (ORNL/TM—6373) **Fluid mechanics model to estimate the leakage of incompressible fluids through labyrinth seals.** Han, J.T. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 29p. AT.

An analytical model for estimating the leakage of incompressible fluids through straight labyrinth seals has been described. Recent developments in theoretical and experimental studies of recirculating flow inside rectangular cavities and of flow in a channel have been incorporated in the model to solve a practical problem. The approach used in this model is different from those of previous ones for compressible fluids in which the gas-dynamics

laws with some empirical coefficients determined from gas data were used. The seal leakages predicted by the model are in reasonable agreement with these measured indirectly in sodium and those obtained for gas at low Mach number and small pressure variations. It can be concluded from this study that the labyrinth seal formed with cavities has less leakage than the one formed with threads if all other conditions are the same. Furthermore, the fluid leakage through straight labyrinth seals (for both cavity and thread types) is strongly dependent upon the seal clearance and pressure drop.

5825 (TID—28756) **Prototype large breeder reactor. Phase II. Follow-on final report.** Anderson, C.A. Jr. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Nov 1977. Contract EY-76-C-03-1141. 573p. AT.

The volume includes five separate reports on tasks performed for the Department of Energy (previously ERDA, RDD) during the period of June 1, 1977 to October 1, 1977. These tasks are follow-on tasks which were assigned to Westinghouse Advanced Reactors Division at the end of Phase II of the PLBR studies. Although a decision was made in April 1977, to discontinue the PLBR studies and not to enter Phase III of the Program, the need to investigate a few outstanding issues prior to the end of FY 1977 was identified. Westinghouse ARD was assigned the following tasks: (1) surveillance and *in-service inspection; (2) piping design and analysis; (3) primary piping integrity-licensability; (4) sulzer cycle—system operation at start-up, shutdown and part-load; and (5) plant simulation and control of superheat cycle.

5826 (WARD-SD—3045-11) **Plastic collapse of a piping elbow: convergence of a finite element shell analysis.** Dhalla, A.K. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Jul 1978. Contract EY-76-C-02-3045-032. 206p. AT.

Deformation characteristics of a representative thin walled elbow were evaluated using a fully compatible doubly-curved isoparametric thin shell element of the MARC program. Geometric nonlinear shell analyses indicate that the solution converges monotonically from the stiff side, with element refinement and incremental load step refinement. Mesh refinement and load step sizes are established to compute the collapse load of an elbow structure. The overall deformation behavior of the elbow is classified into four categories, (a) linear elastic, (b) nearly linear elastic-plastic, (c) elastic-plastic with slight geometric nonlinearity, and (d) elastic-plastic substantially nonlinear. This classification may simplify selection of an analysis method in the design of a piping network.

5827 (WARD-XS—3045-22) **Physics evaluations and applications. Quarterly progress report for period ending April 30, 1978.** Arakali, V.S.; Paik, N.C. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Aug 1978. Contract EY-76-C-02-3045-012. 21p. AT.

Progress is summarized in studies of delayed neutron constants for large heterogeneous LMFBR cores and design analysis of an intermediate-size LMFBR. (DOG)

5828 **Thermal analysis of liquid—metal fast breeder reactors.** Tsang, Y.S.; Coffield, R.D. Jr.; Markley, R.A. La Grange Park, IL; American Nuclear Society (1978). 420p. (TID—28732). American Nuclear Society, La Grange Park, IL.

The book contains the following chapters: (1) general description of LMFBR systems, (2) reactor configurations and operating conditions, (3) thermal design criteria and analysis methods, (4) reactor hydrodynamics, (5) steady-state reactor heat transfer, (6) transient reactor heat transfer, and (7) heat exchangers in LMFBR reactors. (DG)

5829 **Mechanical properties of liquid-metal fast breeder reactor primary piping materials.** Brinkman, C.R.; Sikka, V.K.; King, R.T. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **33**: No. 1, 76-95(Apr 1977).

The available tensile and creep-rupture properties of relevant product forms of Types 316 and 304 stainless steel and associated as-deposited weld metals (i.e., Type 316) are reviewed. A description of both time-dependent and independent behavior is emphasized for Type 316 stainless steel, since this material and its weldments in hot-leg piping applications must operate at temperatures within the creep range. Therefore, elevated-temperature fatigue and creep-fatigue interaction of Type 316 stainless steel are discussed over the temperature range from 566 to 593°C for both air and sodium environments.

5830 **Effect of chemistry variations on the short-term rupture life and tensile properties of 20% cold-worked type 316 stainless steel.** Duncan, D.R.; Paxton, M.M. (Hanford Engineering Development Lab., WA). *Nucl. Technol.:* **33**: No. 1, 112-119(Apr 1977).

The effects of compositional variations on the rupture life of 20% cold-worked Type 316 stainless steel were investigated at 19-ksi (131-MPa) uniaxial tensile stress and at 1400°F (1033 K). Forty-nine different alloys were studied, with compositional variations from nominal in carbon, nitrogen, phosphorus, sulfur, boron, manganese, copper, silicon, molybdenum, cobalt, chromium and nickel. This alloy and cold-work level represents the duct and fuel cladding material choice for the first four core loadings of the Fast Flux Test Facility, a key element in the Liquid-Metal Fast Breeder Reactor Program. Tensile properties of four of the alloys were studied at temperatures from room temperature to 1600°F (1144 K). Boron, nitrogen, and molybdenum plus silicon additions significantly increased rupture life, while chromium and carbon additions decreased rupture life. Molybdenum plus silicon additions increased yield and ultimate strength and ductility at 1200°F (922 K) and below.

REGULATION AND LICENSING

5831 (NUREG—0020(Vol.2)(No.8)) **Licensed operating reactors. Operating units status report, data as of 7-31-78.** (Nuclear Regulatory Commission, Washington, DC (USA)). Aug 1978. 185p. NTIS $10.00.

The report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices and IE Headquarters; and the third section is an appendix containing comparative statistics of U.S. nuclear/fossil capacity, identification of nuclear power plants within regional Electric Reliability Councils, the relative status of U.S. nuclear electric production to all U.S. electric production by state, and selected Edison Electric Institute operating statistics.

5832 (NUREG—0030(Vol.1)(No.8)) **Nuclear power plants. Construction status report, data as of July 31, 1978.** (Nuclear Regulatory Commission, Washington, DC (USA)). Aug 1978. 233p. NTIS $10.00.

Data are presented on the construction status of U.S. commercial nuclear power plants as of July 31, 1978. Included are data on licensing activities which affect construction schedules as well as detailed information on construction activities and schedules. (DG)

5833 (NUREG—0380(Vol.2)(No.6)) **Program summary report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Management and Program Analysis). 23 Jun 1978. 94p. NTIS $12.50.

The report provides summary information on all phases of nuclear regulation, and is intended as an information and decision-making tool for mid- and upper-level management of the Nuclear Regulatory Commission. The report is divided functionally into ten sections: (1) nuclear power plants in the United States, (2) operating nuclear power plants, (3) reactors under construction, (4) operating license applications under NRC review, (5) construction permit applications and special projects under NRC review, (6) ACRS and ASLBP, (7) nuclear materials, (8) standards and regulations, (9) research projects, and (10) foreign reactors.

5834 (NUREG/CR—0044) **Hiring qualifications for inspection and enforcement personnel.** Bartley, H.J.; Balodis, I.; Harrison, O.J.; Heyer, F.H.K.; Hughes, A.L.; Ittleman, C.; Kraas, I.W. (General Research Corp., McLean, VA (USA)). May 1978. 94p. NTIS $6.00.

The document is the General Research Corporation (GRC) report on Task IV, which called for the development of hiring qualifications for designated positions in NRC/IE Headquarters and the regions, and the conduct of a labor market survey. The research involved developing a hiring qualifications format; collecting pertinent data, including that from Tasks I, II, and III; and validating the results with the division directors and the Chief, Career Management Branch, in HQ NRC/IE. A major finding of the labor market survey is that the future supply of engineers and scientists may be inadequate to meet the demands of activities designed to increase domestic energy supplies. Hiring qualifications for all positions in HQ NRC/IE and the regions, not specifically exempted by NRC/IE, are included in the report. Recommendations presented in the report are all within the implementing authority of Headquarters, NRC/IE.

5835 (RDT-INDEX—(10-78)) **RDT standards: index.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Oct 1978. Contract W-7405-ENG-26. 24p. RSO.

5836 (RDT-STATUS—(10-78)) **RDT standards. Status report.** (Oak Ridge National Lab., TN (USA)). Oct 1978. Contract W-7405-ENG-26. 24p. RSO.

5837 **Enforced standards of competence, full disclosure, and public control for the U.S. Nuclear Power Industry.** Wood, L.D. (Office of the Judge Advocate General of the Navy, Washington, DC). *At. Energy Law J.:* **18**: No. 1, 1-82(Spr 1976).

Some of the past faults of the nuclear power industry to properly inform the public concerning the risks and benefits of

nuclear power or to seek the advice and consent of the public or their elected representatives concerning the matters of nuclear policy are pointed out. Some related problems concerning how to ensure that information which the public needs for evaluation of nuclear energy is disclosed publicly and how the will of this informed public should influence the construction of nuclear power plants are discussed. The facts of the case, In the Matter of Virginia Electric and Power Company ("North Anna Decision") which was significant for its innovation in nuclear regulatory law, are set forth; and the holdings of law from the Atomic Safety and Licensing Board's (ASLB) of the U.S. Nuclear Regulatory Commission's (NRC) decision in the case are reviewed. A brief discussion of the benefits and risks which the nuclear power industry presents for Americans and their environment is included. Certain dangerous tendencies of the nuclear industry as a whole are examined. The specific issue of disclosure of information by the nuclear industry to the NRC is examined in order to make clear the imperative necessity for full disclosure. Problems related to disclosure to the public by the nuclear power industry and by NRC are examined. The article takes the stand, after a discussion of the public hearings which the NRC conducts concerning nuclear power plant construction and operating licenses, that these public hearings do not now adequately serve to inform and consult the public, and that NRC hearing requirements should be modified by Congress. On the premise that full disclosure is important, consideration is given to how both existing and recommended disclosure requirements can be enforced. Finally, governmental mechanisms by which the American people can gain significant control over the siting and construction of nuclear power plants are discussed.

ECONOMICS

5838 (CONF-771203—, pp 399-401) **Nuclear-solar energy strategy.** Hofmann, P.L. (Battelle Memorial Inst., Columbus, OH). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5839 (CONF-771203—, pp 403-405) **Impact of management analysis on the nuclear energy alternative.** Kurstedt, H.A. Jr.; Nachlas, J.A.; Kurstedt, P.S. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5840 (R—2304-DOE) **Cost analysis of light water reactor power plants.** Mooz, W.E. (RAND Corp., Santa Monica, CA (USA)). Jun 1978. Contract EX-76-C-01-2337. 92p. Dep. NTIS, PC A05/MF A01.

A statistical analysis is presented of the capital costs of light water reactor (LWR) electrical power plants. The objective is twofold: to determine what factors are statistically related to capital costs and to produce a methodology for estimating these costs. The analysis in the study is based on the time and cost data that are available on U.S. nuclear power plants. Out of a total of about 60 operating plants, useful capital-cost data were available on only 39 plants. In addition, construction-time data were available on about 65 plants, and data on completed construction permit applications were available for about 132 plants. The cost data were first systematically adjusted to constant dollars. Then multivariate regression analyses were performed by using independent variables consisting of various physical and locational characteristics of the plants. The dependent variables analyzed were the time required to obtain a construction permit, the construction time, and the capital cost.

FUEL CYCLE

REFER ALSO TO CITATION(S) 5300, 5310

5841 (ANL/RAS/NASAP—78-2) **Safety-licensing assessment of NASAP reactor concepts and fuel cycle facilities.** Lipinski, W.C.; Prohammer, F.G.; van Erp, J.B.; Seefeldt, W.B. (Argonne National Lab., IL (USA)). Jun 1978. Contract W-31-109-ENG-38. 43p. Dep. NTIS, PC A03/MF A01.

Assessments are presented of the safety/licensability of reactor concepts based on information supplied by the Nonproliferation Alternative Systems Assessment Program (NASAP) characterization contractors in their updated responses to the data package for NASAP Rolling Report II. The assessment of the LMFBR includes information from a characterization contractor on alternate fuel cycles but does not include information provided by a characterization contractor on plant-related safety issues. The information provided by the characterization contractors was supplemented by assessments provided by the U. S. Nuclear Regulatory Commission.

5842 (ANL-Trans—1135) **Analysis of possible fuel cycles from the standpoint of proliferation, resource preservation and waste disposal.** Boehm, H.; Engelmann, P.; Kessler, G.; Maerkl, H.; Stoll, W. Jul 1978. Translation of paper given at 1978 Hannover Reactor Conference, April 4—7, 1978. (CONF-780465—1). 40p. Dep. NTIS, PC A03/MF A01.

From Reactor congress; Hannover, F.R. Germany (4 Apr 1978).

A brief survey is given of the most important fuel cycles and a rough analysis is given of the fuel cycles from the standpoints of proliferation, the state of technical implementation, resource conservation, and waste disposal. Of the wide variety of possible combinations of fuel cycles and reactor types, only a few have progressed so far in terms of technical implementation that it seems possible to introduce them industrially within the next decade. However, rapid industrial introduction is a necessary prerequisite in order for the higher proliferation resistance of a certain cycle, for example, to be effective in terms of a worldwide reduction in the risk of proliferation. The discussion of proliferation has shown that none of the fuel cycles which seem theoretically possible today can be considered inherently proliferation-resistant in the strictest sense from a technical standpoint. Occurrence of separated sensitive material within a fuel cycle can be prevented safely only with the open fuel cycles which work with weakly or medium enriched uranium. A mentionable improvement in present utilization of natural uranium presupposes a closed cycle (i.e., including recycling) and a definite increase in utilization of uranium, as is important especially for countries which are low in resources, is possible only with breeder reactors.

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 5033, 6173

5843 (CONF-771203—, pp 561-562) **Hydrogen energy transport systems and nuclear heat: a promising way to conserve fossil energy resources.** Laughon, K.O.; Swisher, J.H. (Dept. of Energy, Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

5844 (LA—7435-PR) **Transport and reactor theory. Progress report, April 1—June 30, 1978.** Miller, W.F. Jr.; Dudziak, D.J.; O'Dell, R.D.; Alcouffe, R.E.; Gomez, M.F. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 30p. Dep. NTIS, PC A03/MF A01.

Progress is summarized in the following study areas: fission reactor neutronics, radiation shielding and fusion reactor nucleonics, and supporting research and reactor safety.

5845 (NUREG/CP—0004(Vol.3), pp 1003-1016) **Fission foils and alloys containing fissile materials prepared at CBNM.** Van Audenhove, J.; De Vievre, P.; Pauwels, J. (Central Bureau for Nuclear Measurements, Geel, Belgium). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Equipment has been set up for the preparation of UF_4 and PuF_3. Conventional vacuum evaporation systems devised with multi-substrates fixtures allowing simultaneous preparation of a considerable number of deposits have been evaluated. The resulting actinide deposits are intercalibrated by relative alpha counting and characterized by isotope dilution mass spectrometry (IDMS). The paper reports on the achievement on ^{239}Pu deposits. The paper also gives information concerning the availability at CBNM of potential neutron dosimeter alloys containing certified amounts of fissile material.

5846 (NUREG/CP—0004(Vol.3), pp 1251-1261) **Benchmark integral spectrum measurements in single materials for the resolution of uncertainties in data and methods.** Block, R.C.; Becker, M.; Malaviya, B.K. (Rensselaer Polytechnic Inst., Troy, NY). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Techniques for the measurement of fast neutron flux as a function of position in an assembly have been developed to the stage where precision measurements with accurately defined source and geometry conditions can provide the basis for benchmark experiments in single materials. At Rensselaer a combined expermental and analytical program of neutron integral spectrum measurements in single materials has resulted in a critical evaluation of errors contained in existing data sets. This has been demonstrated for the deep minima in the iron scattering cross section, for the inelastic scattering matrices in ^{238}U, and for elastic scattering structure in sodium. This program concentrated upon the time-of-flight method in which large single-material assemblies were pulsed with a high-powered electron linac. Analysis has emphasized development of special analytical models and interactive graphics procedures to facilitate rapid interpretation of theory-experiment discrepancies which are observed in precise conventional computer calculations. The techniques and methods developed for benchmark integral spectra can be applied directly to dosimetry problems.

5847 (NUREG/CP—0004(Vol.3), pp 1333-1364) **Comparison of neutron spectrum unfolding codes.** Zijp, W.L.; Baard, J.H.; Nolthenius, H.J. (ECN Netherlands Energy Research Foundation, Petten). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The report presents results obtained in a comparison of three promising neutron spectrum unfolding procedures based on the CRYSTAL BALL, RFSP-JUL and SAND-II computer programs. The calculations have been performed for three neutron spectra i.e. CFRMF, ΣΣ and STEK. Two cross section data sets were considered based on a recent SAND-II library and the ENDF/B-IV dosimetry file. The codes give comparable results when good input spectrum information is given. When in particular energy regions (e.g. between 1 keV and 1 MeV) there is no or poor detector response, then the three codes give different output spectra. RFSP-JUL modifies the input spectrum only in those regions where there is appreciable detector response. CRYSTAL BALL and SAND-II extend the modifications also to regions with no or little response. The smoothest modification curve is obtained with CRYSTAL BALL.

5848 (NUREG/CP—0004(Vol.3), pp 1385-1410) **Progress report on the IAEA activity of neutron spectra unfolding by activation technique.** Ertek, C.; Cross, B.; Vlasov, M.F. (International Atomic Energy Agency, Vienna). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The paper reviews the current status and procedures associated with neutron spectrum unfolding by activation technique within the IAEA programme on standardization of reactor radiation measurements. Experimental efforts and calculations related to unfolding are briefly reviewed, including additional activation foils, neutron self-shielding factors, impurities, gamma-ray absorption effects, interlaboratory cooperation, re-evaluation of some cross-sections, scattering effects, and the methods of analysis of neutron flux spectra.

5849 (NUREG/CP—0004(Vol.3), pp 1423-1433) **New data processing technique for reactor neutron dosimetry.** Nakazawa, M.; Sekiguichi, A. (Tokyo Univ.). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

With a view to estimate some unknown dose values together with their accuracy from a set of foil data, a new data processing technique is presented. The technique is based on a variational representation of the dose quantity. The present technique is thought to give an approximate solution to the maximum liklihood method based on the Bayes' theorem and is also regarded as a modified FERDO method for the foil data unfoldings. Another feature of this formulation is shown in discussions of the efficient detector calibration in some standard neutron field, where a new concept "calibration-efficiency" is introduced through a particular error analysis of the calibration procedure.

5850 (NUREG/CP—0004(Vol.3), pp 1435-1448) **Differential neutron spectra unfolding from foil activation data.** Jones, R.E.; McKenzie, J.M.; Romero, L.A. (Sandia Labs., Albuquerque, NM). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The report describes an application of a computer code, IUNFLD, to estimate a differential neutron fluence spectrum based on a set of foil activation data. The code allows several types of supplementary data to be used along with the activation data. The estimate obtained is compared with transport calculations and with estimates obtained with other codes. The advantages of IUNFLD compared with the codes used previously are discussed.

5851 (ORNL/CSD/TM—71) **User's guide and description of the perturbation code modules DGRAD and TPERT.** Tomlinson, E.T.; Lillie, R.A. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 31p. Dep. NTIS, PC A03/MF A01.

Two code modules, TPERT and DGRAD, are described, which when used in conjunction with the DOT IV discrete ordinate neutron transport code provide the user with the capability of performing perturbation calculations. The modules and their input are described. A sample problem is presented to aid in executing these modules.

5852 (ORNL/NUREG/CSD—6) **Nuclear safety guide: TID—7016, Revision 2.** Thomas, J.T. (ed.). (Oak Ridge National Lab., TN (USA)). 1 May 1978. Contract W-7405-ENG-26. 130p. Dep. NTIS, PC A07/MF A01.

The Nuclear Safety Guide was first issued in 1956 as classified AEC report LA-2063 and was reprinted the next year, unclassified, as TID-7016. Revision 1, published in 1961, extended the scope and refined the guiding information. Revision 2 of the Guide differs significantly from its predecessor in that the latter was intentionally conservative in its recommendations. Firmly based on experimental evidence of criticality, the original Guide and the first revision were considered to be of most value to organizations whose activities with fissionable materials were not extensive and, secondarily, that it would serve as a point of departure for members of established nuclear safety teams experienced in the field. The advance of calculational capability has permitted validated calculations to extend and substitute for experimental data. The broadened data base has enabled better interpolation, extension, and understanding of available information, especially in areas previously addressed by undefined but adequate factors of safety. The content has been thereby enriched in qualitative guidance. The information inherently contains, and the user can recapture, the quantitative guidance characteristic of the former Guides by employing appropriate safety factors.

5853 **Thermodynamic properties of metal-water systems at elevated temperatures.** Taylor, D.F. (GE Corp Res and Dev, Schenectady, NY). *J. Electrochem. Soc.;* **125**: No. 5, 808-812(May 1978).

The advent of commercial nuclear power generation has created an increased need for thermodynamic data on metal-water systems at temperatures up to 350°C. The entropy correspondence principle discovered by C.M. Criss and J.W. Cobble provides an excellent means of estimating high-temperature partial molar ionic entropies and hence high-temperature heat capacities, from entropy values at 25°C. It is therefore often possible to calculate both equilibrium constants and standard electrode potentials with surprising accuracy for elevated temperatures. Unfortunately, different conventions have been used by several authors in publishing calculated numerical data. One objective of this work is to clarify these differences. In addition a means of simplifying the calculations is described. This new approach permits rapid modification or augmentation of existing values when more accurate data becomes available, or when information at other temperatures is required. 29 refs.

5854 **Influence of quadratic anisotropy on the decay constant of monoenergetic neutron systems.** Sjostrand, N.G. (Chalmers Univ of Technol, Goteborg, Swed). *Atomkernenergie;* **31**: No. 1, 16-17(1978).

The eigenvalues of the time-dependent transport equation for monoenergetic neutrons have been studied numerically for various combinations of linearly and quadratically anisotropic scattering assuming a space dependence of exp (iBr). In general, the presence of quadratic anisotropy leads to a more complicated eigenvalue spectrum. However, this will usually not involve any new difficulties in the interpretation of experiments. 10 refs.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 5968, 5970, 5973

5855 (BNL-NUREG—24599) **NFAP: the nonlinear finite element analysis program. Users manual; Version 1977.** Prachuktam, S.; Reich, M.; Gardner, D.; Chang, T.Y. (Brookhaven National Lab., Upton, NY (USA)). Mar 1978. Contract EY-76-C-02-0016. 165p. Dep. NTIS, PC A08/MF A01.

A brief outline of the analysis capability together with the input instructions are given for a nonlinear finite element analysis program called NFAP, which is an extended version of the NONSAP Program. Extensions include additional element types, material models and several user's features as further described in the report. Similar to NONSAP, the NFAP program can be used for conducting linear or nonlinear analysis of various structures under static or dynamic loadings. Nonlinearities involve both nonlinear materials and large deformations.

5856 (COO—4039-2) **Modular development mat reinforcing and liners containment/annulus building. Final report supplement. Volume I.** Wainrib, J. (Stone and Webster Engineering Corp., Boston, MA (USA)). Jun 1978. Contract EY-76-C-02-4039. 56p. Dep. NTIS, PC A04/MF A01.

The feasibility of developing a modular system approach for the construction of containment mats has been established. The investigative results obtained from a plant used for the modular study has determined that (1) modularization results in a 10-week reduction in the construction schedule critical path over that for the conventional approach, and (2) modularization is cost effective and could result in a savings of approximately $10,700,000. Accordingly, it is recommended that the modular system approach be adopted as standard practice for the construction of containment mats.

5857 (COO—4120-1) **Comparative analysis of structural concrete quality assurance practices on nine nuclear power plant construction projects. Final report.** Willenbrock, J.H.; Thomas, H.R. Jr.; Burati, J.L. Jr. (Pennsylvania State Univ., University Park (USA)). Jun 1978. Contract EY-76-S-02-4120. 850p. Dep. NTIS, MF A01.

Portions of document are illegible.

The basic objective of this research effort was to perform a comparative analysis of the Quality Assurance practices related to the structural concrete phase on nine nuclear power plant projects which are (or have been) under construction in the United States in the past ten years. This analysis identified the response of each Quality Assurance program to the applicable criteria of 10 CFR Part 50, Appendix B as well as to the pertinent regulatory requirements and industry standards. The major emphasis was placed on the construction aspects of the structural concrete phase of each project. The engineering and design aspects were examined whenever they interfaced with the construction aspects. For those aspects of the Quality Assurance system which can be considered managerial in nature (i.e., organizational relationships, types of Quality Assurance programs, corrective action procedures, etc.) an attempt has been made to present the alternative approaches that were identified. For those aspects of the Quality Assurance system which are technical in nature (i.e., the frequency of testing for slump, compressive strength, etc.) an attempt has been made to present a comparative analysis between projects and in relation to the recommended or mandated practices presented in the appropriate industry codes and standards.

5858 (NUREG/CR—0261) **Evaluation of the plastic characteristics of piping products in relation to ASME code criteria.** Rodabaugh, E.C.; Moore, S.E. (Battelle Columbus Labs., OH (USA)). Jul 1978. Contract W-7405-ENG-26. 116p. (ORNL/Sub—2913/8). Dep. NTIS, PC A06/MF A01.

Theories and test data relevant to the plastic characteristics of piping products are presented and compared with Code Equations in NB-3652 for Class 1 piping; in NC/ND-3652.2 for Class 2 and Class 3 piping. Comparisons are made for (a) straight pipe, (b) elbows, (c) branch connections, and (d) tees. The status of data (or lack of data) for other piping components is discussed. Comparisons are made between available data and the Code equations for two typical piping materials, SA106 Grade B and SA312 TP304, for Code Design Limits, and Service Limits A, B, C, and D. Conditions under which the Code Limits cannot be shown to be conservative from available data are pointed out. Based on the results of the study, recommendations for Code revisions are presented, along with recommendations for additional work.

5859 (ORNL/NUREG/TM—216) **Eddy-current inspection for steam-generator tubing program quarterly progress report for period ending March 31, 1978.** McClung, R.W.; Dodd,C.V.; Deeds, W.E. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 14p. (NUREG/CR—1064). Dep. NTIS, PC A02/MF A01.

Eddy-current methods provide the best in-service inspection of steam generator tubing, but present techniques can produce ambiguity because of the many independent variable that affect the signals. The current development program will use existing mathematical models and develop or modify computer programs to design optimum probes, instrumentation, and techniques for multifrequency, multiproperty examinations. Interactive calculations and experimental measurements are made with the use of modular eddy-current instrumentation and a minicomputer. These establish the coefficients for the complex equations that define the values of the desired properties (and the attainable accuracy) despite changes in other significant variables. The final eddy-current instruments will contain on-board microcomputers for real-time data processing and interpretation. Current progress is being made in establishing the necessary computer codes, beginning in construction of some of the basic modules for the instrumentation, and acquisition of selected tubing reference standards.

5860 **Conduction centrifugal electromagnetic pump.** Bonciani, L. (Univ di Pisa, Ist di Fis Gen e Appl, Italy). *Energ. Nucl. (Milan);* **25**: No. 2, 92-102(Feb 1978).

After a general introduction on the characteristics of conduction and induction electromagnetic pumps, the model of a particular type of conduction centrifugal electromagnetic pump is at first illustrated; a simplified theory of the pump operational principle is then given, as well as a relation between pump head and capacity. Working at null capacity is also described from both the theoretical and experimental viewpoints.

5861 **Evaluation of the thermal shock fracture toughness of reactor graphites by arc discharge heating.** Sato, S.; Awaji, H.; Akuzawa, H. (Univ of Ibaraki, Hitachi, Jpn). *Carbon;* **16**: No. 2, 103-109(1978).

This paper presents a new technique to determine the thermal shock fracture toughness by a basic analysis of stress intensity factors of the disk with an edge crack. The thermal shock fracture toughness is defined as K$sub IC$k/E$alpha$ (K$sub IC$ standing for fracture toughness value of the mode I; k for thermal conductivity; E for Young's modulus; $alpha$ for thermal expansion coefficient) and is determined en bloc by measuring the threshold electric power of the arc discharge heating produced when an edge crack propagates in the disk. 10 refs.

CONTROL SYSTEMS

5862 (CONF-771203—, pp 761-763) **Application of computer animation for dynamic display in complex energy systems.** Jones, R.B. (Sandia Labs., Albuquerque, NM). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5863 (HEDL-TME—77-109) **Breeder reactor reference control materials. Semiannual report, July—December 1977.** Roake, W.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1978. Contract EY-76-C-14-2170. 43p. AT.

Progress on neutron absorber development activities from July 1977 through December 1977 is presented. Included in the report are descriptions of activities related to performance analyses, development testing and fabrication technology.

5864 **Applications of the game theory to the evaluation of nuclear power plant dynamic characteristics.** Pavelescu, M.; Kitowski, J. (Inst of At Phys, Bucharest, Rom). *Energ. Nucl. (Milan);* **25**: No. 3, 135-142(Mar 1978).

Applications of the game theory to the evaluation of nuclear power plant dynamic characteristics, utilizing the bimatrix "non-zero sum" game, are presented in this article. In particular, the conditions are examined under which maximum power level and maximum plant efficiency are simultaneously achieved by controlling the bypass valve. 10 refs.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 6571, 6572, 6580, 6582, 6583

5865 (UCID—17824(Rev.1)) **Seismic safety margin research program. Program plan, Revision I.** Smith, P.D.; Tokarz, F.J.; Bernreuter, D.L.; Cummings, G.E.; Chou, C.K.; Vagliente, V.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jul 1978. Contract W-7405-ENG-48. 115p. Dep. NTIS, PC A06/MF A01.

The overall objective of the SSMRP is to develop mathematical models that realistically predict the probability of radioactive

releases from seismically induced events in nuclear power plants. These models will be used for four purposes: (1) To perform sensitivity studies to determine the weak links in seismic methodology. The weak links will then be improved by research and development. (2) To estimate the probability of release for a plant. It is believed that the major difficulty in the program will be to obtain acceptably small confidence limits on the probability of release. (3) To estimate the conservatisms in the Standard Review Plan (SRP) seismic design methodology. This will be done by comparing the results of the SRP methodology and the methodology resulting from the research and development in (1). (4) To develop an improved seismic design methodology based on probability. The Phase I objective proposed in this report is to develop mathematical models which will accomplish the purposes No. 1 and No. 2 with simplified assumptions such as linear elastic analysis, limited assessment on component fragility (considering only accident sequences leading to core melt), and simplified safety system.

5866 Difficulties with the implementation of nuclear waste disposal. Levi, H.W. (Hahn-Meitner-Inst fuer Kernforsch, Berlin, Ger). *At. Strom;* **24**: No. 1, 5-8(Jan-Feb 1978). (In German).

Nuclear waste disposal is certainly not an unsolved problem. There is an efficient, scientifically and technically based overall concept for disposal. For many separate processes in this concept, operational experience with industrial installations or with demonstrator installations is already available. It is shown that in some areas, however, the technical difficulties are not the only ones, but also difficulties having political as well as psychological origins which are equally significant.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 6578

5867 (CONF-771203—, pp 603-606) **Radiation hazards and clean energy.** Rasmussen, G.D. (Citizens Against Radioactive Pollution, Fort Lauderdale, FL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5868 (NUREG/CR—0140) **In-plant source term measurements at Fort Calhoun Station, Unit 1.** Dyer, N.C.; Bunting, R.L.; Croney, S.T. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1978. 204p. NTIS $9.25.

The report presents data obtained from an in-plant source term measurement program conducted for the Office of Nuclear Regulatory Research in support of the Effluent Treatment Systems Branch of the Office of Nuclear Reactor Regulation. The objective of this program is to provide operational data that can be used in the generic evaluation of plant system design in the licensing process and for updating of the calculational models used by the NRC staff in their evaluation of radioactive waste management systems for operating pressurized water reactors. A data base is provided for radioisotope inventory in plant systems, radioactive waste management system performance, and source terms for both liquid and gaseous systems. Data presented were obtained at the Fort Calhoun Station-Unit 1, operated by the Omaha Public Power District (OPPD), located at Blair, Nebraska. In-plant measurements were conducted during the time period from August, 1976 through February 1977. This plant is the first of a planned series of six (6) operating PWR's to be studied.

CHEMICAL AND THERMAL EFFLUENTS

5869 (ORNL/TM—6435) **Offshore heat dissipation for nuclear energy centers.** Bauman, H.F. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 41p. Dep. NTIS, PC A03/MF A01.

The technical, environmental, and economic aspects of utilizing the ocean or other large water bodies for the dissipation of reject heat from Nuclear Energy Centers (NECs) were investigated. An NEC in concept is an aggregate of nuclear power plants of 10 GW(e) capacity or greater on a common site. The use of once-through cooling for large power installations offers advantages including higher thermal efficiencies, especially under summer peak-load conditions, compared to closed-cycle cooling systems. A disadvantage of once-through cooling is the potential for greater adverse impacts on the aquatic environment. A concept is presented for minimizing the impacts of such systems by placing water intake and discharge locations relatively distant from shore in deeper water than has heretofore been the practice. This technique would avoid impacts on relatively biologically productive and ecologically sensitive shallow inshore areas. The NEC itself would be set back from the shoreline so that recreational use of the shore area would not be impaired. The characteristics of a heat-dissipation system of the size required for a NEC were predicted from the known characteristics of a smaller system by applying hydraulic scaling laws. The results showed that adequate heat dissipation can be obtained from NEC-sized systems located in water of appropriate depth. Offshore intake and discharge structures would be connected to the NEC pump house on shore via tunnels or buried pipelines. Tunnels have the advantage that shoreline and beach areas would not be disturbed. The cost of an offshore heat-dissipation system depends on the characteristics of the site, particularly the distance to suitably deep water and the type of soil or rock in which water conduits would be constructed. For a favorable site, the cost of an offshore system is estimated to be less than the cost of a closed-cycle system.

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 5803, 5830, 5863, 5931, 5955, 5956, 5958, 5959, 5960, 6275

5870 (HEDL-SA—1441) **Handling of sodium for the FFTF.** Ballif, J.L.; Meadows, G.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 15p. Dep. NTIS, MF A01.

Portions of document are illegible.

Based on the High Temperature Sodium Facility (HTSF) experience and the extensive design efforts for FFTF, procedures are in place for the unloading of the tank cars and for the fill of the FFTF reactor. Special precautions have been taken to provide safe handling and to accommodate contingencies in operation. These contingencies include special protective suits allowing personnel to enter and correct conditions arising from fill operations in the course of moving 7.71×10^5 kg (1.7×10^6 lbs) of sodium from the tank cars into the reactor vessel and its loop system.

5871 (HEDL-SA—1513) **LOFT advanced fuel rod instrumentation development.** Billeter, T.R.; Brown, R.L.; Chan, A.I.Y.; Day, C.K.; Meyers, S.C.; Sheen, E.M.; Stringer, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1978. Contract EY-76-C-14-2170. 41p. (CONF-7805119—1). Dep. NTIS, PC A03/MF A01.

From Power burst facility contractors meeting; Silver Springs, MD, USA (10 May 1978).

Advanced fuel rod instrumentation for the Loss of Fluid Test (LOFT) reactor is being developed by the Hanford Engineering Development Laboratory for the Nuclear Regulatory Commission. This effort calls for development of sensors to measure fuel rod axial motion, fuel centerline temperature (to 2200°C), fuel rod plenum gas pressure (to 2500 psig), and plenum gas temperature (to 1500°F). A parallel test and evaluation of several modified commercial sensors was undertaken and will result in commercial availability of the final qualified sensors. Necessary test facilities were prepared for the development and evaluation effort. Tests to date indicate a three coil Linear Variable Differential Transformer (LVDT), operated from temperature compensating signal source and processing electronics, will meet the desired requirements.

5872 (LTR—114-98) **LOFT CIS analysis 1/2"-PCS-6-VA outside penetration S-5B.** Condie, C.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 13 Jul 1978. Contract EY-76-C-07-1570. 62p. (RE-A—78-067). Dep. NTIS, MF A01.

Portions of document are illegible.

Line 1/2"-PCS-6-VA outside the LOFT containment penetration S-5B was analyzed to ASME Code, Subsection NC (Class 2) criteria. This piping is part of the Containment Isolation System. The model considered the piping from the penetration through one isolation valve and to the first wall through which the line passes. Results of this anlysis show that this section of the line will meet Class 2 requirements without modification.

5873 (LTR—123-8) **LOFT CIS analysis penetration S-11B 12" H and V duct.** Condie, C.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 13 Jul 1978. Contract EY-76-C-07-1570. 54p. Dep. NTIS, MF A01.

Portions of document are illegible.

The 12 in. H and V Duct and related piping outside the LOFT containment and connected to containment penetration S-11B was analyzed to ASME Code, Subsection NC (Class 2) criteria. This duct is part of the Containment Isolation System. The model considered the duct from the containment O.D. outward through the second isolation valve. Results of this analysis show that this section of the line will meet Class 2 requirements without modification.

5874 (LTR—133-2) **LOFT CIS analysis 3"-DW-1-E inside containment penetration S-5C.** Moha, J.E. (Idaho National Engineering

Lab., Idaho Falls (USA)). 2 Aug 1978. Contract EY-76-C-07-1570. 53p. (RE-A—78-155). Dep. NTIS, MF A01.

Portions of document are illegible.

A stress analysis was performed on the 3"-DW-1-E piping system inside containment penetration S-5C. Deadweight, thermal expansion, and seismic loads were considered. The results indicate that this piping will meet ASME Section III, Class 2 requirements.

5875 (LTR—141-78) **LOFT advanced densitometer L1-4 test.** Wood, D.B. (Idaho National Engineering Lab., Idaho Falls (USA)). 28 Jun 1978. Contract EY-76-C-07-1570. 79p. Dep. NTIS, PC A05/MF A01.

The report covers the PC-2, C-beam chordal average density measurement made on the loss-of-fluid test (LOFT) primary coolant system hot leg during the L1-4 nonnuclear loss-of-coolant accident (LOCA) test conducted May 3, 1977. The P-2, C-beam, or LOFT advanced densitometer, used was of the pulse height analysis/energy discrimination, or nuclear hardened type to be used for LOFT nuclear tests. The L1-4 test verified the applicability of pulse height analysis/energy discrimination techniques of the nuclear hardened gamma densitometer. Test results show that the reactor coolant fluid chordal average density can be calculated from gamma radiation source signal measured count rate data.

5876 (LTR—1111-44) **LPWR fuel assembly characteristics.** Russell, M.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 27 Jul 1978. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

The purpose of the report is to document the LPWR fuel assembly characteristics from which the LOFT fuel bundle material and dimension design choices were derived.

5877 (LTR—1111-45) **LOFT core inlet and outlet flow arrangement diagrams.** Russell, M.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 27 Jul 1978. Contract EY-76-C-05-1570. 16p. Dep. NTIS, PC A02/MF A01.

The purpose of the report is to show the flow path and flow measurement device arrangements in the LOFT core inlet and outlet regions. The assembly composites are diagrammed in detail and are useful in understanding the flow distributions upstream and downstream of the core region.

5878 (LTR—1111-46) **LOFT fuel prototypes, models, and mockups.** Russell, M.L. (Idaho National Engineering Lab., Idaho Falls (USA)). 27 Jul 1978. Contract EY-76-C-07-1570. 8p. Dep. NTIS, PC A02/MF A01.

The report provides a list of and information concerning the prototypes, models, and mockups that were constructed for LOFT Fuel design verification tests, proof-of-fabrication demonstrations, and operator training qualifications.

5879 (LTR—1111-54) **Postirradiation metallurgical techniques to estimate LOFT peak cladding temperatures.** Olsen, C.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 1 Aug 1978. Contract EY-76-C-07-1570. 80p. Dep. NTIS, PC A05/MF A01.

A comprehensive review is presented of Zircaloy microstructure and oxidation characteristics. This information will be used to estimate LOFT peak cladding temperatures by metallographic analysis. Cladding temperatures expected for the LOFT L2-3 and L2-4 tests will be between 1050 and 1400°K and their estimations present unique problems in using current metallographic data and techniques.

5880 (LTR—1115-34(Suppl.1)) **Mechanical analysis of LOFT reactor internals due to loss of coolant accidents.** Miller, G.K. (Idaho National Engineering Lab., Idaho Falls (USA)). 10 Jul 1978. Contract EY-76-C-07-1570. 23p. (RE-E—77-189(Suppl.1)). Dep. NTIS, PC A02/MF A01.

A linear elastic analysis of the LOFT reactor internals was conducted to demonstrate the structural integrity of the reactor system during two Loss-of-Coolant Accidents (LOCA). Time dependent pressure transients were used to predict the behavior of the internals for the following LOCA's: 14" 15 msec reactor vessel nozzle hot leg break; and 14" 15 msec reactor vessel nozzle cold leg break. For the most severe design LOCA (Cold Leg LOCA), the LOFT reactor internals can safely withstand stresses due to a combination of pressure transient loading and seismic loading.

5881 (LTR—1334-3) **LOFT CIS analysis: 1"-IG-I-56-B outside penetration S-5A.** Condie, C.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 13 Jul 1978. Contract EY-76-C-07-1570. 39p. (RE-A—78-052). Dep. NTIS, PC A03/MF A01.

Portions of document are illegible.

Line 1"-IG-I-56-B and related piping outside the LOFT containment and connected to containment penetration S-5A was analyzed to ASME Code, Subsection NC (Class 2) criteria. This line is part of the Containment Isolation System. The model considered the line from the containment O.D. outward to the first support past the first isolation valve. Results of this analysis show that this section of line will meet Class 2 requirements without modification.

5882 (NUREG/CP—0004(Vol.3), pp 1177-1191) **Utilization of standard and reference neutron fields at NBS.** Eisenhauer, C.M.; Gilliam, D.M.; Grundl, J.A.; Spiegel, V. (National Bureau of Standards, Washington, DC). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Several neutron fields whose absolute intensity and spectrum are known sufficiently well to serve as calibration facilities for reactor dosimetry are now operational at NBS. These include a fission-neutron spectrum generated by a small point source of ^{252}Cf (phi approximately 1.5 x 10^7 n/cm^2 sec at 5 cm distance), an intermediate-energy standard neutron field (ISNF) at the center of a spherical cavity in the thermal column of the NBS reactor (phi approximately 10^9 n/cm^2-sec), and a near-1/E spectrum in the same location with about twice that flux. For the ^{252}Cf facility recent investigations are discussed such as intercomparison of source strength with other laboratories, response of integral detectors in this spectrum, and evaluation of the differential spectrum. The ISNF facility is described, and some preliminary integral measurements are discussed.

5883 (NUREG/CP—0004(Vol.3), pp 1205-1206) **Reactor dosimetry calibrations in the Big Ten critical assembly.** Barr, D.W.; Hansen, G.E. (Los Alamos Scientific Lab., NM). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Eleven irradiations of foil packs located in the central region of Big Ten were made for the Interlaboratory Reaction Rate Program. Each irradiation was at a nominal 10^{15} fluence and the principal fluence monitor was the National Bureau of Standards' double fission chamber containing ^{235}U and ^{238}U deposits and located at the center of Big Ten. Secondary monitors consisted of three external fission chambers and two internal foil sets containing Au, In, and Al. Activities of one set were counted at the LASL and the other at the Hanford Engineering Developement Laboratory. The uncertainty in relative fluence for each irradiation was +-0.3%.

5884 (NUREG/CP—0004(Vol.3), pp 1207-1221) **Radiometric reaction rate measurements in CFRMF and Big-10.** Greenwood, R.C. (EG and G Idaho, Inc., Idaho Falls, ID); Helmer, R.G.; Rogers, J.W.; Popek, R.J.; Heinrich, R.R.; Dudey, N.D.; Kellogg, L.S.; Zimmer, W.H. 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Foils of various fissile and nonfissile materials commonly used in neutron dosimetry have been irradiated in the CFRMF, Idaho and Big-10 Los Alamos. Following these irradiations quantitative γ-ray counting was undertaken by five separate groups at four laboratories. Each group used independently calibrated γ-ray detectors; either Ge(Li) or NaI(Tl). These measurements were made as a part of the Interlaboratory Reaction Rate (ILRR) program. Intercomparison of the reaction rate values obtained by each group show good consistency, with individual variations from the average reaction rates generally being less than +-2%. Based upon this consistency and the estimated uncertainties in the nuclear decay parameters the absolute accuracies of these reaction rates are estimated at +-2% (1 sigma). Integral cross section values have been deduced for these reactions in CFRMF and Big-10.

5885 (NUREG/CP—0004(Vol.3), pp 1223-1236) **Several dosimetry studies in the fast neutron source reactor "YAYOI".** Sekiguchi, A. (Tokyo Univ.); Nakazawa, M.; Kosako, T.; Wakabayashi, H.; Akiyama, M. 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Neutron flux and spectra in the YAYOI core-center field have been well characterized through the detector intercomparison studies. Spectra are summarized in an efficient parameter representation form which is useful for neutron dose evaluation. An intermediate neutron field with near 1/E spectrum shape has been developed in the center of the octagonal lead pile driven by YAYOI core. Calculated neutron flux and spectra by two dimensional transport code have been in good agreement with the experimental results

within +- 10% above 0.2 MeV and +- 20% below 0.2 MeV. Its usefulness as a standard neutron field is discussed. Absorbed dose measurements have been also carried out at the core-center field with three different techniques; calorimeter, Fricke-dosimeter and foil detector set used with a thermo-luminescent dosimeter, and a good agreement has been obtained especially about the neutron dose value.

5886 (NUREG/CP—0004(Vol.3), pp 1237-1249) **Reactor dosimetry studies at the coupled fast reactivity measurements facility (CFRMF).** Rogers, J.W.; Harker, Y.D.; Millsap, D.A.; Stepan, I.E. (EG and G Idaho, Inc., Idaho Falls, ID). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

An update is presented on the status of reactor dosimetry studies conducted at the Coupled Fast Reactivity Measurements Facility (CFRMF). Subjects of discussion are experimental measurements of flux level, radiation induced heating, flux spatial distributions, integral testing of the spectrum, differential spectrum, integral reaction rates, and theoretical calculations of the spectrum.

5887 (NUREG/CP—0004(Vol.3), pp 1263-1265) **Remark on benchmark neutron fields at the Physikalisch-Technische Bundesanstalt, Brunschweig.** Alberts, W.G. (comp.). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The objectives and requirements for dosimetry benchmark neutron fields were defined at the IAEA Consultants' Meeting on Integral Cross-Section Measurements in Standard Neutron Fields, Vienna 1976, (INDC(SEC)-54/L+Dos., INDC(NDS)-81/L+M). The following list reviews the work on benchmark neutron fields and their applications at the PTB.

5888 (NUREG/CP—0004(Vol.3), pp 1323-1331) **Distribution of fission yields for fission spectrum neutron-induced fission of uranium-238 from the White Sands Missile Range fast burst reactor.** Harris, D.C.; Beck, J.N.; Raines, W.L.; Harvey, J.T.; Inn, K.G.W.; Meason, J.L.; Wright, H.L. (Univ. of Arkansas, Fayetteville). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

The mass-yield distribution for the neutron-induced fission of ^{238}U by degraded fission spectrum neutrons with an average energy of 1.52 MeV has been measured radiochemically for 26 mass chains in the region A = 89 to 153. Germanium-lithium gamma-ray spectroscopy coupled with beta-particle counting techniques was used to determine the absolute activities of each nuclide measured. The absolute cumulative fission yield of mass chain 140 (^{140}Ba-^{140}La) was determined to be 6.07 +- 0.24, and all other reported yields were measured relative to that value. Measured yields ranged from a maximum of 6.33 +- 0.55 for ^{103}Ru on the light mass wing and 6.54 +- 0.28 for ^{133}I on the heavy mass wing to a minimum of 0.030 +- 0.007 for ^{121}Sn in the valley region. Results from this investigation provide a consistent set of cumulative mass yields from ^{238}U fission induced by a well-characterized neutron spectrum.

5889 (ORNL/TM—6344) **Technical specifications for the pool critical assembly.** (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

Technical specifications for the ORNL-PCA Reactor are presented concerning safety limits and limiting safety system settings, limiting conditions for operation, surveillance requirements, design features, and administrative controls.

5890 (ORNL/TM—6468) **Bulk Shielding Facility quarterly report, January—March 1978.** Hurt, S.S. III; Lance, E.D.; Thomas, J.R. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

The BSR operated at an average power level of 1,952 kW for 68.71% of the time during January, February, and March. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The PCA was used in training programs and was operated on twenty-eight occasions. Nuclear engineering students from the University of Tennessee, the University of Oklahoma, and Louisiana State University, or Tennessee Valley Authority (TVA) personnel from Sequoyah and Watts Bar Nuclear Power Plants actively participated in training sessions.

5891 (ORNL/TM—6578) **High Flux Isotope Reactor. Quarterly report, April—June 1978.** Corbett, B.L.; McCord, R.V.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

Routine reactor operation with three end-of-cycle shutdowns and two mid-cycle shutdowns resulted in an on-stream time of 88.7%. The outer control plates and the No. 1 ionization chamber were replaced.

5892 (TID—28669) **LOFT monthly progress report for May 1978.** (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1978. Contract EY-76-C-07-1570. 162p. Dep. NTIS, PC A08/MF A01.

Cost/budget data are presented together with data on LOFT operation and performance. (DG)

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

REFER ALSO TO CITATION(S) 5974

5893 (UNI—736) **N Reactor pressure tube 1350 postirradiation examination.** Cook, D.J. (United Nuclear Industries, Inc., Richland, WA (USA)). 3 Mar 1977. Contract EY-76-C-06-1857. 19p. Dep. NTIS, PC A02/MF A01.

The N Reactor pressure tubes were fabricated from Zircaloy-2 primarily due to the excellent corrosion resistance, low neutron absorption, and high strength properties of this alloy. Irradiation damage mechanisms increase the strength and decrease the ductility of the Zircaloy-2. Irradiation data available at the time the tubes were installed indicated that fast neutron irradiation damage mechanisms would not decrease the ductility to unacceptable levels over the estimated plant life of 25 to 30 years. However, because the tubes are a primary coolant system component and only limited data are available on irradiation effects at high fluences, a Postirradiation Examination (PIE) program was developed to assure that service factors do not compromise pressure tube integrity essential to reactor safety. The PIE program requires that a pressure tube be periodically removed from the reactor for destructive testing. The N Reactor Technical Specifications specify that the frequency of pressure tube removal and examination be based upon the previous PIE test results. Four pressure tubes were examined before tube 1350, and the test results were summarized in individual reports. PIE results on tube 1350 were summarized along with the test results on the previous four tubes in a previous report. The purpose of this report is to present in detail the results on PIE of pressure tube 1350, and, in particular, document the technique by which the fracture toughness of the pressure tube was determined.

5894 (UNI—739) **Flow testing of N Reactor fuel charges.** Pociluyko, M. (United Nuclear Industries, Inc., Richland, WA (USA)). 15 Mar 1977. Contract EY-76-C-06-1857. 27p. Dep. NTIS, PC A03/MF A01.

The hydraulic characteristics of process tube and connectors in the NPR-PCE Full Scale Facility were determined for each of four designated column charges using Mark IA and/or Mark IV fuel elements. This involved pressure drop measurements at various flows and temperatures while maintaining outlet pressure at 1600 psig. The purpose of testing was to obtain data for development of suitable pressure drop versus flow correlations required for the Safety Analysis Report update program.

5895 (UNI-NUSAR—662) **Evaluation of two-phase pressure drop characteristics for the N Reactor fuel.** Cohn, P.D.; Peistrup, P.E. (United Nuclear Industries, Inc., Richland, WA (USA)). 19 Sep 1977. Contract EY-76-C-06-1857. 32p. Dep. NTIS, PC A03/MF A01.

The report provides an evaluation of the two-phase pressure drop characteristics of the N-Reactor fuel. Several subjects related to two-phase flow performance are analyzed in the report; updated correlations and application methods are also described.

PROPULSION REACTORS

5896 (DOE/ASMP—3060-15) **Investigation of finite difference recession computation techniques applied to a nonlinear recession problem.** Randall, J.D. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Mar 1978. Contract EX-76-A-16-3060. 156p. (ANSP-M—15). Dep. NTIS, PC A08/MF A01.

This report presents comparisons of results of five implicit and explicit finite difference recession computation techniques with results from a more accurate "benchmark" solution applied to a simple one-dimensional nonlinear ablation problem. In the comparison problem a semi-infinite solid is subjected to a constant heat flux at its surface and the rate of recession is controlled by the solid material's latent heat of fusion. All thermal properties are assumed

constant. The five finite difference methods include three front node dropping schemes, a back node dropping scheme, and a method in which the ablation problem is embedded in an inverse heat conduction problem and no nodes are dropped. Constancy of thermal properties and the semiinfinite and one-dimensional nature of the problem at hand are not necessary assumptions in applying the methods studied to more general problems. The best of the methods studied will be incorporated into APL's Standard Heat Transfer Program.

REACTOR SAFETY

5897 (ANL—78-10) **Proceedings of the third post-accident heat removal information exchange.** Baker, L. Jr.; Bingle, J.D. (eds.). (Argonne National Lab., IL (USA)). 1977. Contract W-31-109-ENG-38. 454p. (CONF-771170—). Dep. NTIS, PC A20/MF A01.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

Separate abstracts are included for 49 of the papers presented concerning heat distribution and criticality considerations, particulate-bed phenomena, pool heat transfer and melt-front phenomena, behavior of heated concrete and sodium-concrete interactions, design-related studies, gas bubbling and boiling effects, and materials interactions at high temperatures and experimental methods.

5898 (ANL—78-10, pp 5-8) **Role of mechanistic analysis in providing PAHR initial conditions.** Jackson, J.F. (Los Alamos Scientific Lab., NM). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The objective of this paper is to discuss how Postaccident Heat Removal (PAHR) calculations interface with the earlier accident phases in overall mechanistic accident analyses, to briefly review the evolution of the transition phase as an important path in LMFBR core disruptive accidents, and to assess the impact of the transition phase on PAHR analyses.

5899 (ANL—78-10, pp 9-14) **Views on post-accident heat removal.** Marchese, A.R. (Nuclear Regulatory Commission, Washington, DC). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Some thoughts on the technical needs, fundamental direction, and relative emphasis that should be characteristic of studies on post-accident heat removal are presented.

5900 (ANL—78-10, pp 17-24) **Distribution of fission product decay heat.** Turland, B.D.; Peckover, R.S. (Culham Lab., Abingdon, Eng.). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Data on the total decay heating rate in both thermal and fast reactors are reviewed. The decay heats produced by each fission product element in a fast reactor are given for various times between 20 minutes and 4 months after shutdown. The application of this data in PAHR studies is examined.

5901 (ANL—78-10, pp 26-34) **Current state of analysis of recriticality under PAHR conditions.** Abramson, P.B. (Argonne National Lab., IL). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

In the highly unlikely event of failure to scram following a loss of coolant flow in an LMFBR, fuel pins would melt and fuel, cladding, and coolant would be redistributed. The redistribution of materials is generically the most difficult of the reactor safety analysis problems. Since as materials relocate, their hydrodynamic and thermodynamic interactions are altered, any error in the calculation of the relocations is rapidly compounded to a point that what is calculated may have very little resemblence to reality. Attempts to deterministically calculate these material interactions and motions have taken on a parametric nature in an effort to provide a reasonable set of bounds on the macroscopic accident consequences (such as the potential challenge to the containment). Unfortunately, while some efforts have been fruitful, many of these parametric attempts have resulted in sets of bounds which are so wide as to provide no useful information. Because each material in the reactor has specific effects upon the neutronic behavior, and because a typical LMFBR contains so much fissionable material that a relatively small fraction of the orifinal core can itself cause a prompt critical configuration, and because the effects of a neutronic prompt critical excursion are felt neither hydrodynamically nor thermodynamically until the configuration is reached, we do not have the ability to rule out by deterministic analysis the occurrence of second prompt critical excursion (recriticality). The current state of analytical efforts to understand recriticality is reviewed.

5902 (ANL—78-10, pp 35-46) **Secondary criticality evaluations of postulated core melt-down accidents in early-sized LMFBR's.** Harless, W.H.; Talwar, B.; Gluekler, E.L. (General Electric Co., Sunnyvale, CA). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Secondary criticality analyses have been performed for an early-sized LMFBR. The results indicate that recriticality will occur only as a result of extremely unlikely combinations of failures which lead to melt-down of a large portion of the reactor core, subsequent formation of a relatively pure fuel layer, and/or substantial vessel deformation. Design features were identified that could be used to eliminate recriticality or mitigate its effects if needed to meet safety requirements. The presently existing large uncertainties in the containment response and radiological consequences of single or multiple recriticalities may be reduced with the aid of dynamic analyses that couple neutronic, thermal, and hydrodynamic methods.

5903 (ANL—78-10, pp 49-60) **Preliminary results from initial in-pile debris bed experiments.** Rivard, J.B. (Sandia Labs., Albuquerque, NM). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The initial series of three experiments in the ACPR, designated D-1, D-2, and D-3, was designed to provide basic data on the cooling capacity of representative debris beds under typical accident conditions. Important issues addressed include: (1) whether or not bed depth is an influencing parameter on cooling capacity; (2) what the influence of sodium subcooling is; and (3) how the results correlate with the results of nonreactor experiments and with analytical treatments. Besides providing this frame of reference for safety assessment, it was expected that an initial understanding of bed phenomena would be gained, the details of which could be determined in future experiments. This paper reports preliminary results from the D-series of three experiments.

5904 (ANL—78-10, pp 62-72) **Effect of particle size distribution and non-heated constituents on debris bed dry-out.** Dhir, V.K.; Catton, I. (Univ. of California, Los Angeles). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Past studies of debris bed dry-out have been made using beds of a single particle size (UCLA) or a particle size distribution that attempted simulation of TREAT tests or ANL experiments (ANL, SANDIA). A systematic variation of the particle size distribution has not yet been made. It is the purpose of this work to report on a study of the effect of particle size distribution on debris bed dry-out. Another aspect of this work considered the effect of mixtures of unheated and heated constituents on dry-out. Measurements were also made of segregated beds. The dry-out heat flux data are compared with models based on semi-theoretical correlations developed earlier for deep beds.

5905 (ANL—78-10, pp 74-80) **Particulate bed formation and phenomena.** Gabor, J.D.; Sowa, E.S.; Pavlik, J.R.; Cassulo, J.C. (Argonne National Lab., IL). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The mechanics of particulate debris formation by interaction of molten-core material and sodium and the subsequent phenomena of sodium boiling within the interstices of the particulate debris are important elements in Post-accident Heat Removal analyses. Recent large-scale particulate-bed-formation tests and investigations on channel formation and hydraulic phenomenon associated with heat removal from fragmented core debris are reported here.

5906 (ANL—78-10, pp 81-87) **Experimental studies of a heat generating porous bed.** Lee, D.O.; Nilson, R.H. (Sandia Labs., Albuquerque, NM). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The paper describes experimental observations and qualitative interpretations of flow patterns and temperature distributions for a series of steady state bench experiments in which fission product decay is simulated by Joule heating of the liquid phase. Both single-phase and two-phase boiling phenomena are examined. Particular emphasis is given to the influence of subcooling at the upper surface of a boiling bed. In addition, a brief discussion of similitude parameters and experimental scaling is presented. These considerations suggest a good degree of similarity between the D2 series of in pile experiments at Sandia and the suppportive simulant experiments which are reported here.

5907 (ANL—78-10, pp 88-91) **Network model for free convection within internally heated porous media.** Conrad, P.W. 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Using a somewhat unusual approach, a technique for calculating the steady state fluid motion and temperature distribution due to free convection in a heat generating porous debris bed has been developed. The micro structure of the bed is modeled as a network of inter-connected tubes of constant cross-section, whose walls transfer heat to a variable density fluid flowing within. The network model represents a compromise between overly simplified tube bundle models and very difficult sphere pack models. Tube lengths, radii and heating rates can be related to debris bed granular size, porosity, composition, etc. A computer code for assembling and solving the equation systems has been developed. Calculations have been made for several network geometries for both uniform and stratified heating rate distributions and for both finite and infinite bed widths.

5908 (ANL—78-10, pp 92-98) **Core debris deposition in the primary heat transport system piping of LMFBRs.** Tsai, S.S. (Brookhaven National Lab., Upton, NY). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

A hypothetical core disruptive accident may lead to the upward ejection of core fuel into the upper sodium plenum of a liquid metal fast breeder reactor (LMFBR). Subsequently, the fuel will quench and fragment in the subcooled sodium. Due to the gravitational force, some of the core debris may settle onto horizontal surfaces in the vessel, and the remainder of the debris will be swept out of the reactor vessel into the primary heat transport system piping. Depending on the sodium flow rate in the primary system piping, the debris will either remain suspended or settle out of the sodium stream. It is assumed that the three primary loops are intact and sodium flow is maintained by the pony motors. Due to the low pony-motor-driven sodium flow rate, the core debris is expected to settle out of the sodium stream and deposit on the bottom walls of the primary piping. It is the purpose of this study to investigate the possibility of forming a debris bed on the piping walls and to assess the coolability of such a bed.

5909 (ANL—78-10, pp 101-112) **Natural convection with internal energy sources: some recent experimental and numerical results with post-accident heat removal applications.** Kulacki, F.A.; Emara, A.A.; Korpela, S.A.; Lambha, N.K.; Min, J.H. (Ohio State Univ., Columbus). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

A summary of recent expermental and numerical results on natural convection driven by uniform volumetric energy sources is presented. An experimental heat transfer correlation for steady convection in a fluid layer bounded from below by a segment of a sphere has been obtained for Rayleigh numbers up to 10^{14}. The layer aspect ratio in these experiments has been varied from 0.148 to 0.703. Tests have also been conducted on the transient response of the layer when subjected to a step change in the Rayleigh number, and preliminary results for flow development times are presented. Numerical solutions for the temperature and velocity fields in laminar convection have been obtained for a horizontal layer and a vertical cylinder. In several cases, the predicted heat transfer coefficients are in good agreement with existing experimental data and/or the results of other theoretical studies.

5910 (ANL—78-10, pp 114-121) **Heat transfer between molten core material and concrete.** Reineke, H.H.; Rinkleff, L.; Schramm, R. (Technische Universitaet, Hanover). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

In a hypothetical core meltdown accident of a light water reactor four temporal phases can be distinguished: (1) the heat-up of the core until the core structure may fail, (2) after the failure of the grid plate the water left in the lower plenum is evaporated and a molten pool is formed, (3) in the third phase the pressure vessel wall is heated up and will finally fail, and (4) as soon as the molten core material has penetrated the pressure vessel wall it attacks the concrete beneath the pressure vessel. During the last phase the hot liquid core material melts a deep cavern into the concrete foundation and at last penetrates it. From the destroyed concrete a large quantity of gas is liberated and enhances the containment pressure. This can lead to a failure of the containment by over-pressurization. To determine the penetration of the melt into the concrete quantitatively, the heat transfer between melt and concrete must be known. Therefore, a heat transfer model based on the results of expermental and theoretical investigations was developed to calculate the heat flux between melt and concrete. This model is described along with the studies leading to its development.

5911 (ANL—78-10, pp 122-129) **Molten pool theoretical studies.** Biasi, L. (MATEC, Milan); Castellano, L.; Holtbecker, H. 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

A brief description of the NACOTEC computer program suitable for the study of natural convection in volumetrically heated fluids that utilizes a version of Marker and Cell is presented. Some applications of such a program to situations of interest in PAHR are also presented.

5912 (ANL—78-10, pp 130-140) **Effect of melting of a depleted UO_2 sacrificial bed on the onset of convection in a pool of molten fuel.** Catton, I. (Univ. of California, Los Angeles); Yao, L.S. 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The onset of motion in a horizontal layer of molten fuel with a solid-to-liquid phase change in the downward direction will be considered. The critical Rayleigh number, which characterizes the decay heat, depends strongly on the ratio of the liquid layer thickness (thickness of molten fuel layer over thickness of melt layer), and the temperature boundary conditions. The dependence of the Rayleigh number on the Stephen number will be shown to be weak. The convection pattern indicates that finite amplitude studies must include convective transport of the decay products into the melt layer and that melt rates determined from conduction alone are too low.

5913 (ANL—78-10, pp 141-152) **Heat transfer from a liquid pool to a decomposing solid surface.** Dhir, V.K.; Catton, I.; Cho, D. (Univ. of California, Los Angeles). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Results of an expermental study of heat transfer from water to dry ice in a cylindrical geometry are reported. Two aspects of heat transfer to a decomposing solid surface are addressed. First, it is shown that an experiment must be at least three Taylor wavelengths in size. Second, it is shown that heat transfer is relatively insensitive to location along cavity walls. As a demonstration of the applicability of the results, comparison with recent large scale molten steel-concrete interactions are made.

5914 (ANL—78-10, pp 153-160) **Heat transfer measurements from internally heated liquids enclosed by nonmelting and melting boundaries.** Fieg, G.; Werle, H. (Kernforschungszentrum, Karlsruhe, Ger.). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Heat transfer measurements using a cylindrical convection cell are presented. The nonboiling pool (aspect ratio: height/diameter = $\frac{1}{4}$) is internally heated and the boundaries have equal temperatures. In addition one- and two-dimensional melt front propagation of a pool on a miscible solid has been studied. The influence of the melt density has been investigated in more detail. Downward penetration is compared with calculations based on heat transfer results from one-dimensional convection cells.

5915 (ANL—78-10, pp 161-170) **Some concepts on heat transfer from molten pools to underlying sacrificial beds.** Alsmeyer, H.; Barleon, L.; Guenther, C.; Mueller, U.; Reimann, M. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

If sacrifical bed concepts are employed for core catchers feedback effects on downward heat transfer due to the interaction of the molten fuel and the bed material have to be taken into account. Two special types of interactions will be regarded here. The first is characterized by very small interactions between the pool and the sacrificial bed. This results in a weak feedback on the heat transfer. Therefore modified heat transfer correlations as known for free convective flow may be derived. In analysing the first type of interaction it is useful to consider on one side bed materials which are insoluble in the molten pool of fuel (case 1) and on the other side materials which are fully soluble in it (case 2). The second type of interaction is characterized by a strong interaction of the pool and the sacrificial bed, such as in the case of decomposing concrete (case 3). The gas or steam being released by the decomposition process causes such a strong stirring effect in the molten fuel pool that it becomes nearly isothermal. Heat transfer is no longer governed by natural convection, but is dominated by the gas flow forming an unstable gas layer between the concrete and the melt. In this paper hydraulic models are presented on the basis of which relations for the downward heat transfer are given.

5916 (ANL—78-10, pp 172-178) **Stability of advancing melting fronts to spatial perturbations.** Turland, B.D.; Peckover, R.S.; Dullforce, T.A. (Culham Lab., Abingdon, Eng.). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

In considering the advance of a molten pool into a sacrificial bed, or the melting of support structures by overlying hot debris it is usually assumed that the advancing melt-front is a plane or simple curved surface. Penetration times based on this assumption would be overestimated if the melting front is unstable to small spatial variations in the temperature distribution as then the interface could become very convoluted leading to increased local penetration and possible structural failure. A number of experiments have been carried out using simulant materials to examine the form of advance of melting fronts. The molten pool consisted of an aqueous solution which was provided with internal volumetric (Joule) heating by the passage of electric current through the solution. The pool was placed above a bed of water-soluble wax in a manner analogous to that which has been reported in the published literature. Relevant experiments are described. In addition linear stability analyses for a steadily advancing melting fromt have been carried out.

5917 (ANL—78-10, pp 179-186) **Growth of melting pools in sacrificial materials.** Peckover, R.S.; Turland, B.D.; Whipple, R.T.P. (Culham Lab., Abingdon, Eng.). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

If after a hypothetical reactor core meltdown debris penetrates through the bottom of the reactor vessel it will begin to melt into the material beneath. This may be natural bed rock or a bed of "sacrificial material" placed there against this eventuality. In either case it is necessary to estimate how large a molten pool of material will grow. The case where the molten debris and the sacrificial material are miscible with both radially growing and axisymmetric pools is considered. The amount of heat available for melting the bed consists of the initial heat content of the debris and the integrated fission product decay heat. For a 3 GW(th) reactor the heat content of the debris is around 20 GJ which corresponds to approximately 5 minutes of decay heat. The decay heat generated within the first three years of shutdown (approximately 7×10^4 GJ) corresponds to about 6 hours of full reactor power, so shortly after the formation of a melt-pool its development is essentially independent of the assumed initial conditions.

5918 (ANL—78-10, pp 187-191) **Mechanisms controlling the downward and sideward penetration of a hot liquid pool into a solid.** Farhadieh, R.; Chen, M.M. (Argonne National Lab., IL). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

In the melting processes of molten core debris in strucutres likely to be located below a nuclear reactor housing, the two media are expected to be mutually miscible. The continuous melting and dissolution strongly affects the thermofluidic processes within the liquid pool which in turn affects the melting rate. To gain insight into these physical processes and to obtain a usable correlation, studies of pool growth in one-dimension were undertaken. These studies were concentrated separately on the sideward and downward growth of the liquid pool into solid beds having different thermophysical properties. In the two-dimensional study, the most significant parameter controlling directional growth of the liquid pool was found to be the density ratio of the liquid pool to the melted solid, rho/sub l/rho/sub m/ = rho*. Accordingly, this ratio was the principal parameter considered in the one-dimensional studies.

5919 (ANL—78-10, pp 205-214) **Experimental and theoretical studies on water and gas release from heated concrete.** McCormack, J.D.; Postma, A.K. (Hanford Engineering Development Lab., Richland, WA). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Procedures currently used in licensing of nuclear facilities require analysis of postulated accidents which are more severe than "design basis" events. For breeder program reactors, some accidents in this severe catagory involve spillage of sodium coolant onto concrete protected by a steel liner. Heat transfer through the liner heats the concrete, causing a part of the mixing water and other gases to be driven off. These gases would add to pressure in the containment atmosphere, and the water vapor can form hydrogen if it contacts sodium. Evaluations of containment integrity for such postulated accidents will be aided by knowledge of how much water and other gases are released from heated concrete. Results are presented of a research effort at Hanford Engineering Development Laboratory designed to improve understanding of the release of water and gases from heated concrete.

5920 (ANL—78-10, pp 215-222) **Physical properties and behaviour of heated basaltic concrete.** Peehs, M.; Doerr, W. (Kraftwerk Union Aktiengesellschaft, Erlangen, Ger.). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

To provide a risk analysis for LWR-accidents of very low probability, the research project "Kernschmelzen" of the BMFT was started in the FRG in 1971. The objective of the related R and D-work is to study the consequences of a hypothetical core melting accident. The behavior and properties of heated basaltic concrete are presented.

5921 (ANL—78-10, pp 223-232) **Core debris penetration into concrete.** Baker, L. Jr.; Cheung, F.B.; Bingle, J.D. (Argonne National Lab., IL). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Analyses of the behavior of core debris following an HCDA require a thorough understanding of the interactions of core debris with concrete. The nature of the attack of core debris on the concrete below the reactor cavity is important because it involves the final line of defense against violation of the containment. One of the most important factors to be determined is the ratio of sideward to downward growth of molten core debris pools in concrete. Such a determination requires evaluations of both the "concrete-side" heat transfer and gas release behavior and the "pool-side" heat transfer behavior as well as of the coupling between the two. This paper describes an empirical approach to evaluate the "concrete-side" conditions and outlines a preliminary pool-growth model (GROWS II) which uses this approach. Two sets of representative "pool-side" conditions were used for illustrative purposes. No coupling effects such as the changes in pool heat transfer caused by the gases released from the concrete were considered in these preliminary calculations.

5922 (ANL—78-10, pp 233-242) **Concrete failure modes at elevated temperatures.** Gluekler, E.L. (General Electric Co., Sunnyvale, CA); Dayan, A. 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Local failure modes of concrete at high surface temperatures have been determined based on microstructural investigation and failure surface calculations. Preliminary results indicate that concrete crushing does not occur and spallation would occur only under extreme conditions.

5923 (ANL—78-10, pp 243-249) **Large scale sodium test facility at Sandia Laboratories.** King, D.L.; Smaardyk, J.E.; Sutherland, H.J.; Sallach, R.A. (Sandia Labs., Albuquerque, NM). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The large scale sodium test facility in use at Sandia Laboratories was designed to be used for a wide range of sodium interaction experiments. Of initial concern is the interaction of hot sodium with concrete under conditions similar to accident conditions in any sodium cooled reactor. The tests to be run cover the cases of sodium spills and sprays on bare concrete and on cells with defective steel liners. The initial series of tests in progress at the facility involves rapidly dropping from 20 kg to 225 kg of sodium at temperatures from 550°C to 850°C into contrete crucibles that are representative of the concrete to be used at the Clinch River Breeder Reactor Plant (CRBRP). Specific objectives are to obtain sufficient information to completely describe the sodium/concrete interaction including: reaction rate, heat of reaction, gas evolution and flow, movement of the reaction front, reaction product formation, and the effects of variation of drop temperature and reaction area geometries.

5924 (ANL—78-10, pp 250-257) **Large scale sodium interactions with limestone concrete.** Sallach, R.A.; Smaardyk, J.E.; Sutherland, H.J.; King, D.L.; Dahlgren, D.A. (Sandia Labs., Albuquerque, NM). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

For sodium cooled reactors, knowledge of the interaction of hot sodium with cell liners and, given either a failed liner or a core disruptive accident, the interaction of hot sodium with concrete are necessary for a safety assessment. To better understand what happens when hot sodium contacts concrete, a series of tests is being carried out under conditions which are similar to postulated reactor accident conditions. Specific objectives are to obtain a complete description of the sodium/concrete interaction including heat balance, gas evolution and flow, movement of and heat generation in the reaction zone, reaction product formation, and the layering and movement of the reaction products. The expermental results of the initial three tests of the test series are presented. These tests were "uninstrumented" in that the full array of instrumentation had not yet been installed. The test results do include thermal data from thermocouples immersed in the sodium pool, post-test measurements of penetration depths, and post-test chemical analyses of the reaction products.

5925 (ANL—78-10, pp 258-266) **Intermediate scale sodium-concrete reaction tests.** Hassberger, J.A. (Hanford Engineering Development Lab., Richland, WA). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Twelve intermediate scale, sodium-concrete reaction tests have been completed. These tests involved spilling hot (1250 to 1600°F, 677 to 871°C) sodium onto 1 ft^3 (.028 m^3) specimens of magnetite of limestone concretes. The resulting reactions were allowed to continue for from 2 to 24 hours, at which time the sodium was decanted from the test article. Included are discussions of the observed penetration depths, chemical analyses of the reaction products, characterization of the evolved gases and a brief summary of laboratory scale experiments performed earlier.

5926 (ANL—78-10, pp 267-272) **Hydrogen jet recombination under postulated breeder reactor accident conditions.** Wierman, R.W. (Hanford Engineering Development Lab., Richland, WA). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Certain conditions may be postulated in breeder reactor risk assessments for which the potential of hydrogen release to the reactor containment building needs to be evaluated. One of these conditions is a postulated core melt-through accident followed by cavity liner failure allowing sodium to react with the structural concrete resulting in the release of free hydrogen. If the hydrogen-sodium vapor mixtures in the reactor cavity were to jet into the containment building and inherently self-ignite at the source where they enter the reactor containment building, no immediate hydrogen accumulation would occur. However, as the oxygen in the sealed containment building is consumed by hydrogen and sodium, the oxygen concentration may decrease to a point at which the hydrogen may cease burning. The self-ignition and extinguishment characteristics of hydrogen-sodium jets need to be understood for complete breeder reactor safety analysis. Therefore, experments have been conducted investigating hydrogen jet burning characteristics under conditions similar to those postulated for core melt-through accidents. The data presented below describe the conditions for jet self-ignition and extinguishment using a small-scale apparatus.

5927 (ANL—78-10, pp 275-285) **Heat transfer by natural convection in confined medium.** Grand, D.; Martin, R.; Tenchine, D. (CEN, Grenoble, France). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

In order to estimate the performances of a core-catcher located inside the main vessel of a pool type reactor, one needs to know the heat transfer coefficient between the core-catcher and the surrounding sodium and also the thermal resistance of the large volumes of sodium between the heat source and the outer ultimate cooling circuit. The development of natural convection in the different volumes of sodium separated by metal walls is also of interest.

5928 (ANL—78-10, pp 286-296) **Method for estimating the performances of an internal core-catcher in a pool-type LMFBR.** Kayser, G.; LeRigoleur, C. (Centre d'Etudes Nucleaires, Cadarache, France). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

A large pool-type fast reactor presents two important advantages in concern with PAHR: an important sodium volume with a high heat capacity; and a large diameter allowing the retainment of molten fuel in a very thin layer. The objective of this study is to show the practical interest of these advantages and the possible performances of an internal core catcher.

5929 (ANL—78-10, pp 297-302) **Post accident heat removal after complete plugging of a fuel sub-assembly.** Cazalet, J.; Melis, J.C. (Centre d'Etudes Nucleaires, Cadarache, France). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The problem consists of studying, in the case of a complete plugging of a fuel sub-assembly, the possibility of propagation of the destruction to the neighbouring sub-assemblies. The molten fuel is supposed to be contained in a cooled stainless steel sub-assembly. The main questions to be studied are: (a) heat evacuation by pure conduction; and (b) in the presence of natural convection, what is: (1) the resistance to melting, and (2) the resistance to erosion by the molten fuel of the solid crust. The main item of this note will be the b(1) case.

5930 (ANL—78-10, pp 303-308) **Dynamic behavior of SNR-300 core retention device and experimental support of the design concept.** Friedrich, H.J. (Internationale Atomreaktorbau GmbH, Bergisch Gladbach, Ger.). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Methods and results are presented of temperature course investigations relating to the large Na-pool underneath the reactor vessel after a hypothetical melttrhough of the core debris. Temperature behavior of this pool controls the thermal load of the containment, steam release, aerosole production, and the thermal load of the core catcher components themselves. The SNR-300 Primary System is designed to withstand the consequences of a HDCA without major leakage of sodium. Since there is a good chance to remove the decay heat either by natural convection through the three primary loops or by the six especially protected emergency coolers, no serious rise of the mean sodium temperature can occur.

5931 (ANL—78-10, pp 309-316) **Investigation of margins in FFTF containment design.** Stepnewski, D.D.; Simpson, D.E.; Peak, R.D. (Hanford Engineering Development Lab., Richland, WA). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Analyses are presented of predicted phenomena and containment building trasnients for postulated failures of post-accident heat removal (PAHR) that follow a hypothetical core disruptive accident (HCDA) in the Fast Flux Test Facility (FFTF). The results are included of two cases which typify two classes of failure modes of in-vessel PAHR for FFTF. As previously discussed, a disrupted core would be predicted to remain within the reactor vessel, coolable as a debris bed by the primary HTS loops. There are three independent primary loops; any one loop has sufficient capability to cool the core. If, however, all three loops failed, then the sodium coolant would heat up, reach its boiling point, and eventually boil away into the Reactor Containment Building (RCB). This scenario forms the basis for the "in-vessel" cases treated in subsequent sec-

tions of the paper. On the other hand, if for any reason HCDA core debris were to assume a noncoolable configuration, the fuel could melt its way through successive barriers consisting of the core shield-orifice assemblies, core basket region, and lower dome of the core support structure. If a coolable configuration did not develop in the reactor vessel inlet plenum, the lower vessel head would be penetrated, with molten material release to the guard vessel. It is probable that fuel fragmentation would occur in the guard vessel, resulting in a coolable configuration, a conclusion supported by the ANL M-5 test. If further progression occurred, with penetration of the guard vessel, sodium and core materials would then be released to the reactor cavity floor. This scenario is the basis for "ex-vessel" cases treated in this paper.

5932 (ANL—78-10, pp 317-326) **Evaluations of CRBRP thermal margin beyond the design base.** Schornhorst, J.R.; Strawbridge, L.E.; Bradbury, P. (Westinghouse Advanced Reactors Div., Madison, PA). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

This paper assesses the Thermal Margin Beyond the Design Base (TMBDB). Specifically, the consequences of a whole core melt, resulting in penetration of the reactor vessel and guard vessel are assessed. The plant features provide thermal margin such that containment integrity can be maintained for not less than 24 hours after initiation of the event as required by the Nuclear Regulatory Commission. The design features that provide the thermal margin beyond the design base described are illustrated. Some of these features are provided specifically for TMBDB while other features have augmented capabilities to provide TMBDB.

5933 (ANL—78-10, pp 327-334) **Ex-vessel containment response to a core meltdown.** Pyun, J.J.; Gasser, R.D.; Pratt, W.T.; Bari, R.A. (Brookhaven National Lab., Upton, NY). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The Third Level Thermal Margin (TLTM) design analysis for the Clinch River Breeder Reactor (CRBR) assumes (in the extremely unlikely event of a hypothetical core disruptive accident) that melt-through of the reactor vessel and guard vessel will occur 1000 seconds after shutdown. All of the active core and lower axial blanket together with 4.5×10^6 gm of steel is then distributed over the 1219.2 cm diameter reactor cavity floor. Approximately 544×10^6 gm of sodium at 1050°F is also released into the cavity, and it is assumed that the fuel and steel form a sodium-flooded, self-leveling debris bed. As a consequence of this assumption, all of the decay heat is transferred to the sodium. It is also assumed that the steel liner on the reactor cavity floor fails and is followed by a reaction of sodium with concrete. The purpose of the present investigation is to consider the possibility that a molten fuel and steel pool may exist rather than a sodium-flooded debris bed.

5934 (ANL—78-10, pp 335-342) **Review of containment transients in a 2500 MW/sub t/ sodium cooled breeder reactor following postulated core disruptive accidents.** Armstrong, G.R.; Seeman, S.E. (Hanford Engineering Development Lab., Richland, WA). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Three types of containment configurations for breeder reactors of the 2500 MW(t) class were compared to deterine the typical responses associated with each type to selected hypothetical accident conditions. The study was conducted for ERDA-RDD by HEDL to provide insight as to the sensitivity of accident consequences to various design and phenomenological assumptions, and thereby provide potentially useful input to guidance of R and D activities. The types of containment systems investigated in the study were the single, double and containment-confinement designs. Two types of hypothetical accidents were arbitrarily assumed as bases for the initial conditions in the evaluation—the energetic core disruptive accident and the whole core melt-through accident. More than 20 separate cases were analyzed in which selected design and phenomenological assumptions were varied. The primary computer codes used in the study were CACECO, HAA, and COMRADEX.

5935 (ANL—78-10, pp 343-350) **Effect of chemical reactions on postaccident fuel containment in GCFRs.** Kang, C.S.; Torri, A.; Yang, L. (General Atomic Co., San Diego, CA). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The effect of graphite—fuel—stainless-steel chemical reactions on decay heat removal and containment pressure buildup for a 300-MW(e) GCFR plant following a hypothetical core meltdown accident has been studied. A compatibility experment was first performed to identify the reaction temperatures, followed by heat transfer analyses considering these chemical reactions. Cases with and without external cooling and a variable thermal barrier thickness were considered. Results from these analyses indicated that chemical reactions are significant in reducing heat transfer to the concrete vessel. For most cases, the quantity of CO in the containment was found to be far below the flammability limit. The containment pressure due to helium depressurization and CO generation was also found to be far below the failure limit.

5936 (ANL—78-10, pp 353-360) **Heat transfer in volumetrically-heated pools with gas injection at the boundaries.** Abdel-Khalik, S.I.; Felde, D.K. (Univ. of Wisconsin, Madison). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

A volumetrically-heated pool with noncondensable gas injection at the boundaries is used to simulate the heat transfer processes taking place in molten core debris/concrete systems. Measurements of the upward, downward, and sideward heat transfer rates have been made over wide ranges of internal Rayleigh number ($6.0 \times 10^5 < Ra < 2.7 \times 10^9$), superficial gas velocity ($0 < Vg < 2.5$ cm/min), and pool aspect ratio ($1.32 < W/L < 5.16$). Pools with either an isothermal solid upper boundary or a free surface have been examined. Detailed measurements of the temperature distribution within the pool have also been made. The results indicate that the downward heat transfer rates are significantly increased while the sideward heat transfer rates are slightly affected by gas injection. The heat transfer rates at the pool boundaries are sensitive to the upper surface boundary condition.

5937 (ANL—78-10, pp 361-368) **Bubble-induced heat transfer in a heat generating liquid layer.** Bergholz, R.F.; Bjorge, R. (Argonne National Lab., IL). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The purpose of this investigation is to study the heat transfer behavior of a volumetrically heated liquid layer with gas bubbling from a horizontal, porous, lower boundary. The experimental data obtained are used to develop a correlation for the interfacial heat transfer coefficient for use in PAHR pool growth models. The experimental results also provide information on the upward heat loss due to gas and vapor flow through the liquid layer. Finally, the characteristics of bubble-induced heat transfer at a porous surface are compared with those found in experiments on nucleate boiling.

5938 (ANL—78-10, pp 369-376) **Thermo-fluid mechanics of volume-heated boiling pools.** Greene, G.A.; Jones, O.C. Jr.; Schwarz, C.E. (Brookhaven National Lab., Upton, NY). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

A program to study the bahavior of volume-heated boiling pools has been undertaken at BNL in order to provide meaningful estimates of heat transfer mechanisms in such systems. Emphasis has been placed on developing appropriate scaling parameters to allow results to be applied to prototypical, hypothetical accident conditions in an LMFBR. It has been determined that, within experimental accuracy, a boiling pool seems to exhibit behavior much like a single-phase natural convection system with a much extended laminar film regime to local Rayleigh numbers approximately 10^{12}.

5939 (ANL—78-10, pp 377-386) **Potential for fuel boiling under decay heat conditions.** Kazimi, M.S. (Massachusetts Inst. of Tech., Cambridge). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The conditions under which a fuel pool can be sustained in a boiling steady-state condition due to internal heat generation will be assessed. Such a state is of interest in hypothetical core-melt conditions, in order to define the heat loads to structures as well as the potential for dispersion following a hypothetical accident.

5940 (ANL—78-10, pp 389-397) **Sandia in-core molten fuel pool experiment preliminary results.** Plein, H.G.; Carlson, G.A. (Sandia Labs., Albuquerque, NM). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

The PAHR Molten Fuel Pool experimental program is concerned with the interaction of very hot fuel with reactor structural or sacrificial materials. The approach is to use fission heated fuel to obtain sustained, intrinsic heating which rather closely approximates the decay heated case. This experimental method also allows the fuel to interact with real structural and core retention materials at the actual temperatures of interest. The development of an advanced temperature diagnostic, ultrasonic thermometry, for the molten pool experiments; a materials compatibility study which defined the materials used for containment and insulation for the in-core experiments; and the results of the first three in-core molten pool experiments, two with UO_2-only, and one containing both UO_2 and steel are presented. Plans for future molten pool studies are also discussed.

5941 (ANL—78-10, pp 398-407) **Interaction of heat generating molten UO_2 with structural materials.** Stein, R.P.; Baker, L. Jr.; Gunther, W.H.; Cook, C. (Argonne National Lab., IL). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

An apparatus and technique for the production of confined pools of kg quantities of heat generating molten UO_2 is being used to study interactions with structural materials of interest to LMFBR and GCFR PAHR. Four types of experiments are discussed here: (1) experiments for the purpose of obtaining heat transfer data as well as to obtain information related to certain nonidealities that occur with the apparatus, (2) interaction experiments with magnesia bricks, (3) interaction experiments with stainless steel, and (4) interaction experiments with graphite. The purpose of the last three types of experiments is to obtain information related to the interaction of UO_2 and various structural materials at conditions of interest to hypothetical post accident situations. Thus, internal heat generation rates within the UO_2 were close to those that would pertain during the post accident phase, and, perhaps most important, actual rather than simulant materials were involved.

5942 (ANL—78-10, pp 408-414) **Molten core debris interactions with core containment materials.** Swanson, D.G. (Ivan A. Getting Labs., El Segundo, CA); Zehms, E.H.; Ang, C.Y.; van Paassen, H.L.L. 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

A series of experiments have been performed to study the interactions expected in a hypothetical core meltdown accident between molten core debris and materials that might be used for core containment. The core debris would contain UO_2 and substantial quantities of stainless steel from the fuel cladding and support structures. Many sacrificial-bed concepts have been proposed for core containment in which materials are used that have been identified as having desirable thermal, chemical, and mechanical properties. In the experiments described here, the interactions between molten UO_2 and steel and various materials that might be employed have been investigated on a small scale. Molten UO_2 interactions with MgO brick, low-carbon steel plate, and stainless-steel plate have been studied, and interactions between molten stainless steel and MgO brick and low-carbon steel plate were also examined.

5943 (ANL—78-10, pp 415-423) **Interactions of UO_2 with reactor materials.** Fink, J.K.; Heiberger, J.J.; Leibowitz, L. (Argonne National Lab., IL). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Two sets of in-progress small-scale interaction experiments are discussed. The interaction of UO_2-graphite and stainless steel is being studied from 1894 to 2760 K for varied amounts of stainless steel (0 to 75%). Results of these experiments indicate that, below 2223 K, CO production is inhibited by the presence of stainless steel. Between 2223 K and 2760 K, the rate of CO evolution is significantly increased by the presence of stainless steel, the reaction rate increases with temperature. The interactions of Na_2O-Na_2CO_3 with UO_2, mixtures of UO_2 and stainless steel, and ThO_2 at 1255 K are discussed. Na_2O-Na_2CO_3 interacts with UO_2 forming sodium uranates. Stainless steel particles dissolve in the Na_2O-Na_2CO_3-UO_2 mixture to a limited extent. No reaction was observed between Na_2O-Na_2CO_3 and ThO_2.

5944 (ANL—78-10, pp 425-432) **Measurement of the penetration of molten core materials into concrete using an acoustic technique.** Sutherland, H.J. (Sandia Labs., Albuquerque, NM). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

In a recent article, Sutherland and Kent described a pulse-echo ultrasonic technique which measures the motion, as a function of time, of the interface of two dissimilar materials. They illustrated the technique by monitoring the motion of an ice/flame interface and a concrete/plasma jet interface, and they suggested that this technique could be used to monitor the motion of a molten pool/concrete interface. The technique, with some modifications, has now been used in this second configuration. These modifications and some preliminary results are reported.

5945 (ANL—78-10, pp 433-440) **Sustained molten steel/concrete interactions tests.** Powers, D.A. (Sandia Labs., Albuquerque, NM). 1977.

From 3. post-accident heat removal information exchange; Argonne, IL, USA (2 Nov 1977).

In Proceedings of the third post-accident heat removal information exchange.

Four tests of the sustained interaction between high-temperature steel melts and two varieties of concrete are described. Inductive heating was used to keep the 200 Kg stainless steel melts liquid for periods of up to 20 min. A cover assembly over the melt-concrete system controlled emissions produced by the interactions so that quantification of phenomena produced in the tests could be attempted. Measurements of the gas composition, gas temperature, gas generation rate, aerosol emissions, upward heat-flux from the melt, and melt-temperature were made. Gases liberated from the concrete were found to be chemically reduced principally to carbon monoxide and hydrogen as they passed through the melt. The tests provided some evidence that stainless steel may also catalyze the hydrogenation of carbon monoxide to yield hydrocarbons such as methane, ethene, and ethane in the gas stream.

5946 (ANL/EBR—101) **Compliation of data from EBR-II natural-circulation-test procedure EX-140, Section IV, Addendum 1A.** Gillette, J.L.; Sullivan, J.E.; Tokar, J.V.; Singer, R.M. (Argonne National Lab., Idaho Falls, ID (USA)). May 1978. Contract W-31-109-ENG-38. 257p. AT.

Data from the XX08 natural-circulation Test 1A in EBR-II are presented herein. This test consisted of four separate coastdowns of primary-system flow initiated from approximately 5.5 percent of normal full flow (the flow provided by the auxiliary electromagnetic pump in the reactor outlet pipe of EBR-II). Each coastdown was conducted with a different flow rate of secondary sodium through the intermediate heat exchanger (IHX). Data were obtained with the EBR-II data-acquisition system (DAS) from the normal plant instrumentation, from the INCOT YY07D experiment, and from instrumented subassembly XX08, which had been installed in the reactor just before the test. The necessary corrections for offsets in the raw data collected through the DAS are discussed. The corrected data are graphically presented for each phase of the test.

5947 (BNL-NUREG—50747) **Reactor safety research programs. Quarterly progress report, 1 July—30 September 1977.** Kouts, H.J.C.; Kato, W.Y. (Brookhaven National Lab., Upton, NY (USA)). Oct 1977. Contract EY-76-C-02-0016. 220p. Dep. NTIS, PC A10/MF A01.

HTGR safety evaluation included studies on fission product release; materials, chemistry, and instrumentation; structural evaluation; and analytical safety evaluation. LMFBR work included accident sequence studies, technical coordination of structural integrity, and SSC code development and validation. LWR safety studies included thermal/hydraulic analysis; THOR code development; and appraisal of analysis development in foreign countries.

5948 (CONF-771203—, pp 123-125) **Inherent emergency cooling of liquid metal fast breeder reactors by natural circulation.** Singer, R.M.; Mohr, D. (Argonne National Lab., IL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5949 (CONF-771203—, pp 135-137) **Reactor scram experience for reliability analysis of LMFBR shutdown systems.** Gerstner, M.T.; Edison, G.E. (Westinghouse Electric Corp., Madison, PA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5950 (CONF-771203—, pp 765-767) **Personal decision making, the nuclear dilemma, and the demonstration of power.** Kurstedt, H.A. Jr.; Nachlas, J.A. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5951 (CONF-771203—, pp 773-774) **CRBRP safety study: an assessment of risk.** Piper, H.B.; Conradi, L.L.; Buhl, A.R.; Wood, P.J.; Leaver, D.E.W. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5952 (CRBRP-GEFR—00103) **Analysis of hypothetical core disruptive events in the Clinch River Breeder Reactor Plant.** McElroy, J.L.; Switick, D.M.; Brown, N.W.; Chou, F.M.; Damerow, W.P.; Rodgers, F.C. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Apr 1978. Contract EY-76-C-15-2395. 551p. AT.

The results of hypothetical core disruptive event analyses for the Clinch River Breeder Reactor Plant performed during the period of January 1975 to January 1977 (with the SAS3A and VENUS II computer codes) are reported. The analytical results cover a large number of parametric cases including variations in design parameters, initiating conditions and phenomenological assumptions. Reactor core configurations at the beginning and end of an equilibrium cycle are evaluated. Accident progression branch points leading to either hydraulic pressure (within fuel assembly duct structural capacity) or hydrodynamic pressure (exceeding fuel assembly duct structural capacity) fuel disruption modes are evaluated. The phenomenological processes of molten fuel pools are described and the consequences of energetic recriticality, including Behrens' effects, are examined. The energetic consequences are evaluated based upon both fuel expansion thermodynamic work potential and a relative probability assignment. It is concluded that the structural loads which result from 101 megajoules of available expansion work at sodium slug impact on the reactor closure head (equivalent to 661 megajoules of fuel expansion work to one atmosphere) is an adequate energetic consequence envelope for use in specifying the Structural Margins Beyond the Design Basis.

5953 (GA-A—15055) **HTGR Generic Technology Program: safety, systems and component design and development. Quarterly progress report for the period ending June 30, 1978.** (General Atomic Co., San Diego, CA (USA)). Jul 1978. Contract EY-76-C-03-0167-065. 104p. Dep. NTIS, PC A06/MF A01.

The work documented includes HTGR safety and safety-related studies to better understand and more accurately define safety characteristics and safety margins of GCRs and under postulated accident conditions. Also included are the design, analysis, and testing of the PCRV, liner, penetrations, thermal barrier, reactor internals, steam generator, core auxiliary heat exchanger, and rotating machinery. Design studies and analyses plus experimental procedures and results are discussed and data are presented.

5954 (GEAP-NUREG—21304-9) **BWR blowdown/emergency core cooling. Ninth quarterly progress report, January 1—March 30, 1978.** Hwang, W.S. (General Electric Co., San Jose, CA (USA). Nuclear Energy Engineering Div.). Apr 1978. 29p. NTIS $4.00.

The BD/ECC work completed in the first quarter of 1978 is summarized. Conduction of Matrix Tests 6 and 7, preliminary analysis of the results of Test 6, identification and solution of the internal flow leak observed in Tests 6 and 7, evaluation of the previously reported TLTA jet pump pressure data, conceptual design for the partitioned bundle test, and final design of the flow path for BD/ECC 1B test were the highlights of work accomplished during the period.

5955 (HEDL-SA—1463FP) **Effect of power skew on the FTR TOP.** Yung, S.C.; Wilburn, N.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1978. Contract EY-76-C-14-2170. 36p. (CONF-780622—55). Dep. NTIS, PC A03/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

An enduring program of studies, both experimentally and analytically, on the unprotected Transient Overpower Hypothetical Core Disruptive Accident (TOP-HCDA) of the Liquid Metal Fast Breeder Reactor (LMFBR) has been in progress for a decade or so. The data available from the experiments and the computational methodology improvements have made the recent TOP safety assessments more realistic. The evidences from the in-pile tests in the TREAT facility, such as the axial location of fuel pins' failure towards the upper portion of the pin, and the rather benign nature of Molten Fuel and Coolant Interactions (MFCI) have unambiguously clarified some key issues of earlier TOP accident assessments. However, on the other hand, there is no conclusive assertion that can be made on the post-failure scenarios. No complete sweepout of molten fuel has ever been observed in all TREAT TOP tests performed to date to warrant the complete sweepout assumption in the TOP analysis. As a matter of fact, the fuel blockage has occurred in almost all TREAT TOP tests, at least partial blockage, in the coolant flow paths in the testing apparatus. Arguments on the validity of these TREAT TOP experiments to Fast Test Reactors (FTR) have been raised because of the low coolant flow velocity and low coolant pressure drops in the testing section in their hydraulic simulations and gross power overdriving after fuel pin failure. For the non-prototypicality of hydraulic simulation, it argues that the higher coolant velocity will increase the likelihood of hydraulic fuel sweepout and the higher the system hydraulic pressure will reduce the likelihood of coolant flow reverse. A scrutiny of the hydraulic consequences may reveal that this hydraulic non-prototypicality does not necessarily yield a favorable conclusion to the formation of blockage in the FTR.

5956 (LTR—114-100) **LOFT LOCA: WHAM6 model and code application.** Berta, V.T. (Idaho National Engineering Lab., Idaho Falls (USA)). 27 Jul 1978. Contract EY-76-C-07-1570. 40p. Dep. NTIS, PC A03/MF A01.

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This report documents the WHAM6 analysis of a loss-of-coolant accident (LOCA) pipe break at the reactor vessel. Data derived from this document is to be used to generate loads for the LOCA analysis of the reactor internals.

5957 (NUREG—0474) **Technical update on pressure suppression type containments in use in U.S. light water reactor nuclear power plants.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1978. 184p. NTIS $9.00.

In 1972, Dr. S. H. Hanauer (Technical Advisor to the NRC's Executive Director for Operations) wrote a memorandum that raised several questions on the viability of pressure suppression containment concepts. The concerns raised by Dr. Hanauer have recently become the subject of considerable discussion by several members of the U.S. Congress and public. The report provides a response to these expressed concerns and a status summary for various technical matters that relate to the safety of pressure suppression type containments for light water cooled reactor plants.

5958 (NUREG/CR—0175) **Investigation of the influence of simulated steam generator tube ruptures during loss-of-coolant experiments in the semiscale MOD-1 system.** Cozzuol, J.M.; Hanner, O.M.; Loomis, G.G. (Idaho National Engineering Lab., Idaho Falls (USA)). May 1978. Contract EY-76-C-07-1570. 116p. (TREE-NUREG—1213). Dep. NTIS, PC A06/MF A01.

The potential effects of steam generator tube ruptures during large break loss-of-coolant accidents were investigated in the Semiscale Mod-1 system. As a result of testing, a relatively narrow band of secondary-to-primary mass flow rates with the potential for causing high core heater rod cladding temperatures in the Mod-1 system has been identified. The maximum cladding temperatures for tests which simulated tube rupture flows within this narrow band were below 1315 K. The system hydraulic phenomena which influenced the core thermal behavior during the period of secondary-to-primary flow have also been identified.

5959 (NUREG/CR—0196) **Water Reactor Safety Programs sponsored by the Nuclear Regulatory Commission's Division of Reactor Safety Research. Quarterly technical progress report, January—March 1978.** (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1978. Contract EY-76-C-07-1570. 77p. (TREE-NUREG—1218). Dep. NTIS, PC A06/MF A01.

Water reactor research is summarized for the following programs: Semiscale, LOFT, Thermal Fuels Behavior, Code Development and Analysis, Code Verification and Applications, and the 3-D Project. The Semiscale Program reports progress in converting to a new Mod-3 configuration scaled more directly to a PWR; improved mass flow rate measurement using a full-flow drag screen in two-component fluid flow is reported. The LOFT Experimental Program reports achievement of initial criticality of the LOFT reactor and discusses calculations of loft fuel rod behavior for initial nuclear experiments. The Thermal Fuels Behavior Program reports on the various test series in the PBF reactor (including results of three recent loss-of-coolant experiments) and discusses progress in Halden fuel behavior research and postirradiation examination of reactor fuel. The Code Development and Analysis Program reports release of the RELAP4/MOD6 code, an evaluation of a nonequilibrium post-CHF heat transfer correlation, and development of an improved fuel rod fission gas release model. The Code Verification and Applications Program reports plans for verifying the RELAP4/MOD6 and FRAP-T4 codes, and describes the status of fuel rod analysis code verification. The multinational 3-D Experiment Project reports design, analysis, and instrumentation development in support of German and Japanese reflood experiments.

5960 (NUREG/CR—0230) **LOFT transient (blowdown) critical heat flux tests.** Gottula, R.C. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1978. Contract EY-76-C-07-1570. 169p. (TREE-NUREG—1240). Dep. NTIS, PC A08/MF A01.

Transient (blowdown) Critical Heat Flux (CHF) tests have been performed on two electrically heated 25-rod bundles simulating a portion of the central assembly of the LOFT nuclear reactor core-1. The bundles were identical except that one bundle incorporated simulated rod surface thermocouples similar to the cladding surface thermocouples attached to some of the LOFT fuel rods. The purpose of these tests was to determine the effect of rod surface thermocouples on time-to-CHF under blowdown conditions similar to those in LOFT. A comparison between bundles showed that differences in time-to-CHF were less than 0.45 sec at any location in the bundles and most of the differences were less than 0.20 sec. An analysis of a LOFT hot fuel rod for a L2-4 blowdown test indicated that a difference in time-to-CHF of 0.5 sec would result in only a 17°C difference in peak cladding temperature. Thus, it is inferred that cladding surface thermocouples will not affect time-to-CHF or peak cladding temperature for the nuclear rods in the LOFT core under loss-of-coolant conditions.

5961 (NUREG/CR—0254) **Experiment data report for semiscale MOD-3 reflood heat transfer test S-07-4 (baseline test series).** Gillins, R.L.; Sackett, K.E.; Stanger, K. (Idaho National Engineering Lab., Idaho Falls (USA)). Aug 1978. Contract EY-76-C-07-1570. 184p. (TREE—1224). Dep. NTIS, PC A09/MF A01.

Recorded test data are presented for Test S-07-4 of the Semiscale Mod-3 baseline test series, the first of several Semiscale Mod-3 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a pressurized water reactor (PWR) system. Test S-07-4 was conducted from initial conditions of 421 kPa and average heater rod temperature of 783 K to investigate the response of the Semiscale Mod-3 system to a reflood transient following a simulated double-ended offset shear of the broken loop cold leg piping. The specific objectives of this test were (a) to determine the effect of core length on reflood heat transfer and (b) to evaluate the influence of active broken loop components on core reflood behavior. During the test, cooling water was injected into the vessel lower plenum to simulate emergency core coolant in a PWR. The purpose of the report is to make available the uninterpreted data from Test S-07-4 for future data analysis and test reporting activities.

5962 (NUREG/CR—0273) **PWR Blowdown Heat Transfer Separate-Effects Program: Thermal-Hydraulic Test Facility experimental data report for test 156.** Massengill, G.S.; Hedrick, R.A.; White, M.D. (Oak Ridge National Lab., TN (USA)). 22 Aug 1978. Contract W-7405-ENG-26. 51p. (ORNL/NUREG/TM—235). Dep. NITS, PC E03/MF E03.

Reduced instrument responses are presented for Thermal-Hydraulic Test Facility (THTF) test 156 which is part of the ORNL Pressurized-Water Reactor (PWR) Blowdown Heat Transfer Separate-Effects Program. The objective of the program is to investigate the thermal-hydraulic phenomenon governing the energy transfer and transport processes that occur during a loss-of-coolant accident in a PWR system. Test 156 was conducted to obtain thermal-hydraulic and CHF information in the THTF bundle 1 operating at a low power containing four unpowered rods with a $^1/_2$ nominal depressurization rate. The desired depressurization rate was not achieved. The primary purpose of this report is to make the reduced instrument responses during test 156 available.

5963 (NUREG/CR—0348) **RLPSFLUX: RELAP with surface flux modifications.** Cliff, S.B. (Oak Ridge National Lab., TN (USA)). 10 Jan 1978. Contract W-7405-ENG-26. 169p. (ORNL/NUREG/CSD—5). Dep. NTIS, PC A08/MF A01.

A modification to the RELAP4 computer code, which extends its external specification capabilities to include heat transfer quantities, is described with full discussion of all changes required. Sample output and source listings are included.

5964 (ORNL—5383, pp 73-79) **Nuclear Regulatory Commission programs.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

Program activities and publications prepared in the reactor safety, radiation-release guidelines, safeguards, plutonium recycle, and waste management studies are briefly described. (HDR)

5965 (ORNL/TM—6343) **SIMBO: a simple boiling model of the response of a simulated sodium-cooled breeder reactor subassembly to an undercooling transient.** Garrison, P.W. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 59p. AT.

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A highly simplified thermal-hydraulic code, SIMBO, has been developed to investigate the influence of the fuel-assembly duct wall on the results of a series of boiling tests in the THORS facility at ORNL. The code is based on an implicit solution to a single-channel axial energy transport equation coupled through a film coefficient to an explicit solution to a multiple-radial-node conduction model. A quasi-steady approximation of the momentum equation is used in conjunction with the Martinelli--Lockhart two-phase flow correlation. Predictions made by the model are compared with experimental results from the THORS bundle 6A test series.

5966 (ORNL/TM—6439) **Breeder reactor safety and core systems programs. Progress report, January—March 1978.** Fontana, M.H.; Wantland, J.L. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 91p. AT.

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Progress made during January--March 1978 by the Breeder Reactor Safety and Core Systems Programs at the Oak Ridge National Laboratory is reported. Topics discussed are program coordination, Thermal-Hydraulic Out-of-Reactor Safety (THORS) analysis and data evaluation, THORS Facility operation, Sodium Boiling Test Facility (SBTF), materials for fuel pin simulation, neutronics of a disrupted core, environmental assessment of breeder reactor fuels, model evaluation of breeder reactor radioactivity releases, Nuclear Safety Information Center, central computerized data base for breeder reactor safety codes, and breeder reactor reliability data analysis center.

5967 (PNL—2653-1) **Reactor safety research programs. Quarterly report, 1 January—31 March 1978.** Hooper, J.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1978. Contract EY-76-C-06-1830. 135p. (NUREG/CR—0086). Dep. NTIS, PC A07/MF A01.

Progress is summarized in the following LWR safety-related studies: (1) ultimate heat sink performance measurements, (2) evaluation of atmospheric empirical diffusion data, (3) acoustic emission-flow relationship for in-service monitoring of pressure vessels, (4) steam generator tube integrity, (5) experimental verification of steady state codes, (6) core thermal model development, and (7) fuel subassembly procurement and irradiation test program. (DG)

5968 (RE-A—77-100) **Evaluation of common cause failure analysis techniques.** Wilson, J.R.; Burdick, G.R.; Rooney, J.J. (Idaho National Engineering Lab., Idaho Falls (USA)). Sep 1977. Contract EY-76-C-07-1570. 232p. Dep. NTIS, PC A11/MF A01.

The purpose of the report is to summarize and evaluate the common mode/common cause analysis techniques found in the literature. A decision tree is presented to help the analyst determine the method--or combination of methods--most appropriate for his particular problem. Although this report is written to the analyst familiar with the field of reliability, the introduction does contain a discussion of basic common mode/common cause concepts. This is a preliminary document. The authors would appreciate any reader's suggestions and additional references on significant common cause failure analysis techniques.

5969 (SAND—78-0456C) **Determining safeguards requirements for nuclear power reactors.** Varnado, G.B.; McCloskey, D.J.; Hickman, J.W.; Asselin, S.V.; Ortiz, N.R. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 5p. (CONF-781007—6). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

In the design of safeguards systems for commercial nuclear power plants and in the review of license submittals, it is necessary to determine the systems, components, and plant areas for which protection is required. Sandia Laboratories has conducted several studies to identify the vulnerabilities of nuclear power plants to sabotage or theft, to determine possible consequences of reactor sabotage, to recommend means by which sabotage or theft can be prevented, and to formalize the procedures for determining safeguards requirements for specific plants. The studies have addressed only the subnational (terrorist) threat and thus have concentrated on the problem of sabotage which could endanger public health and safety. This paper discusses: (1) the general characteristics of nuclear power plants which influence safeguards requirements, (2) a basic strategy for protection of reactor plants, (3) an analytic approach which can be used to systematically identify the protection requirements for specific plants under a variety of protection strategies, and (4) selected results of the application of the analytic approach to a typical nuclear power plant.

5970 (TID—28759) **Mitigating effects in the plastic failure of shells subjected to axially dependent dynamic pressure loadings. Interim report (Part I of summary report), September 1976—February 1979.** Horvay, G.; Veluswami, M.A.; Stockton, F. (Massachusetts Univ., Amherst (USA). Dept. of Civil Engineering). Jul 1978. Contract EY-76-S-02-4122. 103p. Dep. NTIS, PC A06/MF A01.

Study of plastic failure during LOCA, as carried out by previous investigators, appears to take insufficient account of certain potential mitigating effects associated with the loading condition.

The study is aimed at clarifying some of these, such as, (1) the axial non-uniformity of the pressure distribution, (2) the effect of rise time (non-impulsive loading), and (3) elastic unloading (e.g., during an axially traveling wave). The report deals with Phase I of the project. It is found that there is a slight reduction in the fundamental component of the response to the excitation. However, the first harmonic component of the response is not insignificant, and so the hoped-for improvement in the response behavior does not materialize. Study of Phase II of the investigation is about to be started. In the light of recent studies by many workers in the field, Phase III no longer seems to be propitious, and in the conclusions of the report a modification is suggested.

5971 (TREE—1287) **RIO: a program to determine reliability importance and allocate optimal reliability goals.** Poloski, J.P. (Idaho National Engineering Lab., Idaho Falls (USA)). Sep 1978. Contract EY-76-C-07-1570. 87p. Dep. NTIS, MF A01.

Portions of document are illegible.

The designer of a nuclear plant must know the plant's associated risk limitations so that he can design the plant accordingly. To design a safety system, he must understand its importance and how it relates to the overall plant risk. The computer program RIO can aid the designer to understand a system's contribution to the plant's overall risk. The methodology developed and presented was sponsored by the Nuclear Research Applications Division of the Department of Energy for use in the Gas Cooled Fast Breeder Reactor (GCFR) Program. The principal motivation behind its development was the need to translate nuclear plants safety goals into reliability goals for systems which make up that plant. The method described herein will make use of the GCFR Accident Initiation and Progression Analyses (AIPA) event trees and other models in order to determine these reliability goals.

5972 (UCI—17922-8) **ARAC feasibility study for the NRC phase I: progress report.** Sauter, G.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1978. Contract W-7405-ENG-48. 43p. Dep. NTIS, PC A03/MF A01.

The report describes the results obtained and preliminary conclusions drawn to date from an NRC-funded study of the feasibility of incorporating the services of the Atmospheric Release Advisory Capability (ARAC) into the emergency response plans and programs of the Rancho Seco Nuclear Generating Station and the appropriate state and local agencies. The report describes the reasons why Rancho Seco was selected as the study site, the roles of the various agencies in response to an abnormal radiological release at Rancho Seco, and the potential benefits and costs of implementing ARAC at Rancho Seco.

5973 (UCID—17824(Rev.II)) **Seismic safety margin research program. Program plan, Revision II.** Smith, P.D.; Tokarz, F.J.; Bernreuter, D.L.; Cummings, G.E.; Chou, C.K.; Vagliente, V.N.; Johnson, J.J.; Dong, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Aug 1978. Contract W-7405-ENG-48. 105p. Dep. NTIS, PC A06/MF A01.

The document has been prepared pursuant to the second meeting of the Senior Research Review Group of the Seismic Safety Margin Research Program (SSMRP), which was held on June 15, 16, 1978. The major portion of the material contained in the document is descriptions of specific subtasks to be performed on the SSMRP. This is preceded by a brief discussion of the objective of the SSMRP and the approach to be used. Specific subtasks to be performed in Phase I of the SSMRP are as follows: (1) plant/site selection, (2) seismic input, (3) soil structure interaction, (4) structural building response, (5) structural sub-system response, (6) fragility, (7) system analysis, and (8) Phase II task definition.

5974 (UNI-NUSAR—19) **Design change No. 3418 Criticality Alarm System (CAS) 105 N.** Blackaby, W.B. (United Nuclear Industries, Inc., Richland, WA (USA)). 16 Sep 1976. Contract EY-76-C-06-1857. 43p. Dep. NTIS, PC A03/MF A01.

Portions of document are illegible.

The changes, within the last ten years, in regulatory criteria for concept and design of a Criticality Alarm System (CAS) mandates the installation of a new measurement and alarm system to replace those channels previously assigned to the N-Reactor Tracerlab Area Radiation Monitoring System. The areas to be monitored for a criticality event will be the green fuel storage area, Room 181, the discharge pit area, the segregation basin, and the irradiated fuel storage area. Two identical systems will be installed on opposite sides of the reactor because of the large distance between the areas of survey. Each system will employ three General Electric Log Radiation Monitors (GE LRM) utilizing gamma sensitive ionization chambers as the detecting device. A digital comparator using a "two of three" majority minimum will be used to provide the decision for criticality alarm. The criticality alarm circuit will initiate audio and visual alarms. Annunciators will illuminate in the control room and the plant standard audible alarm (ah-oo-gah horn) for a criticality will sound in the area of coverage. The ah-oo-gah horns will be controlled by the Tracerlab Area Radiation Monitoring System as well as by the GE LRM. The ah-oo-gah horns thus will sound for a high level alarm condition as well as for a criticality event.

5975 **Microcomputer-based radiation monitoring system for nuclear power plants.** Eichenlaub, D.P. (Westinghouse Electr Corp, Hunt Valley, Md). *IEEE Trans. Ind. Electron. Control Instrum.;* **IECI-25**: No. 2, 112-117(May 1978).

When microcomputers replace analog circuitry, advantages such as improved accuracy, better data analysis, and automatic reporting must be evaluated against possible tradeoffs in cost, reliability, and response time. The Westinghouse Radiation Monitoring System (RMS) is an instrumentation system used in nuclear power plants to measure levels of radioactivity. An analog system recently redesigned to use microcomputers, the RMS offers a good example of how microcomputers can successfully replace analog circuitry by placing primary emphasis on system design. 3 refs.

5976 **Sodium boiling experiments in the frame of fast reactor safety studies.** Cenni, R.; Meneghello, S.; Ricci, F.; Romagnoli, M.; Savoni, O.; Scarano, G.; Sirtori, L. (CNEN, Cent Stud Nucl, Casaccia, Rome, Italy). *Energ. Nucl. (Milan);* **25**: No. 3, 123-134(Mar 1978). (In Italian).

This article presents the sodium boiling experiments recently performed at the Centro Studi Nucleari della Casaccia (Rome) in the frame of the fast reactor safety studies being carried out by CNEN. In particular, it describes three types of experiments, performed on test-sections mounted on the ENA-2 loop, in order to study the influence of the heat flux axial distribution, single phase transient and radial temperature profile on boiling dynamics. A preliminary analysis allows a rough extrapolation of the results obtained on a seven-rod test section to the case of a fast reactor fuel element. 10 refs.

5977 **Analysis of spray cooling of hollow rod cladding following a loss-of-coolant accident (LOCA).** Sawan, M.E. (Univ of Alexandria, Egypt). *Atomkernenergie;* **31**: No. 2, 122-126(1978).

An analytical two-dimensional rewetting model is presented to determine the rewetting velocity for a hollow rod cladding during spray cooling process. The effect of the cladding geometry on the rewetting velocity is investigated with the conclusion that the velocity increases with decreasing ratio of inner radius to thickness. The model is used to reduce available experimental data, applicable to rewetting by spray cooling, to yield values of the heat transfer coefficient. Correlations which give the heat transfer coefficient in terms of spray rate, inlet subcooling and pressure are developed. A value of 1.85*10$sup 5$ kcal/h.m$sup 2$.$degree$C is recommended for LOCA analysis under spray cooling conditions. 16 refs.

5978 **Analytical simulations in the field of two-phase-flow. an overview of present state and future necessities.** Karwatt, H.; Werner, W.; Wolfert, K. (Tech Univ Muenchen, Ger). *Atomkernenergie;* **31**: No. 1, 7-15(1978).

The analytical simulation of two-phase-flow phenomena is a very important tool in determining the design basis of engineered safeguards in the field of reactor technology. Specific areas of interest are the simulation of loss-of-coolant accident events, operational transients, and anticipated transients without scram (ATWS). Fluid dynamic parameters of interest are, in general, surface conditions of structures in terms of specific mass flow rates and local enthalpies, as well as pressure distributions to determine forces which may affect the geometry of structures. In some cases (e.g. pressure suppression systems) mixing effects under non-equilibrium conditions such as bubble collapse influence fluid-structure interactions which are considered to be important boundary conditions for the design of these structures. 30 refs.

5979 **Central computerized data base for LMFBR safety codes.** Greene, N.M.; Flanagan, G.F.; Alter, H. (Oak Ridge National Lab., TN). *CODATA Bull.;* No. 23, 29-31(May 1977).

From 5. international CODATA conference; Boulder, CO, USA (Jun 1976).

The status of the development of the SACRD (Safety Analysis Computerized Reactor Data) data base is described. The overall data base effort is concerned with gathering, evaluating, and distributing all necessary nondesign-related data required to perform safety analysis. These analyses cover a wide range of situations: initiating events and protected accidents, loss of subassembly integrity, core disassembly, structural response, aerosol transport and biological dose, and post-accident heat removal. The data in SACRD are structured by type, property, material, and version.

5980 (ORNL-tr—4647) **Close location of nuclear power plants.** (Statens Straalskyddsinstitut, Stockholm (Sweden)). 1974. Translation of Swedish report 1974-08-21. 24p. Dep. NTIS, PC A02/MF A01.

The issue of radiation protection as related to nuclear power plant site selection is examined. Those aspects of radiation protection that are of significance when comparing the consequences of reactor

accidents as a function of the distance of the reactor site from major communities are emphasized.

ENERGY STORAGE

COMPRESSED GAS

REFER ALSO TO CITATION(S) 6031

5981 (R—76-952161-5(Vol.1)) **Preliminary feasibility evaluation of compressed air storage power systems. Volume I. Final technical report.** Giramonti, A.J. (United Technologies Research Center, East Hartford, CT (USA)). Dec 1976. 419p. Dep. NTIS, PC A18/MF A01.

A preliminary technical, economic, and environmental feasibility evaluation of generating peak power with a compressed air power system incorporating a modified state-of-the-art gas turbine and a hydraulically compensated, mined, hard-rock cavern is described. The compressor and turbine sections of the gas turbine would be alternately coupled to a motor/generator for operation during different time periods. During nighttime and weekend off-peak periods, low-cost power would be used to compress air which would be stored in the underground cavern. During subsequent daytime peak-load periods the compressed air would be withdrawn from storage, mixed with fuel, burned, and expanded through the turbines to generate peak power. This program consists of a three-phase analytical study effort which provided an in-depth, engineering investigation into the uncertainties associated with the air storage concept. Results are presented covering the siting potential and economics for hard-rock storage caverns, the types of aboveground equipment which could be used with suitable modifications, system performance and economics, and the potential for electric utility application. The technical approach was based on technology currently available, although in some cases not yet reduced to commercial practice. By focussing on state-of-the-art technology it was possible to identify a low-risk design approach capable of producing about 250 MW which could be considered for near-term commercial application. The design approach has the distinct advantage of providing considerable flexibility with respect to storage conditions without altering the basic configuration or expensive low-pressure components.

5982 **Combined compress air storage: low Btu coal gasification power plant.** Karthsounes, G.T.; Sather, N.F. (to Dept. of Energy). US Patent Application 844,084. 20 Oct 1977. 13p.

An electrical generating power plant includes a Compressed Air Energy Storage System (CAES) fueled with low BTU coal gas generated in a continuously operating high pressure coal gasifier system. This system is used in coordination with a continuously operating main power generating plant to store excess power generated during off-peak hours from the power generating plant, and to return the stored energy as peak power to the power generating plant when needed. The excess coal gas which is produced by the coal gasifier during off-peak hours is stored in a coal gas reservoir. During peak hours the stored coal gas is combined with the output of the coal gasifier to fuel the gas turbines and ultimately supply electrical power to the base power plant.

PUMPED HYDRO

REFER ALSO TO CITATION(S) 6100

FLYWHEELS

REFER ALSO TO CITATION(S) 4990

5983 (CONF-771203—, pp 575-576) **Energy storage by flywheels: a new flywheel concept.** Holtzclaw, E.H.; Schneider, R.T. (Univ. of Florida, Gainesville). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5984 (UCRL—13888) **Interlaminar and stacking sequence considerations for composite flywheels. Final report.** Kulkarni, S. (Materials Sciences Corp., Blue Bell, PA (USA)). Jul 1978. Contract W-7405-ENG-48. 10p. Dep. NTIS, MF A01.

Portions of document are illegible.

The design of fiber-reinforced composite flywheels for energy storage systems (FESS) presents a challenging and at times, difficult task. The design complexity of composite flywheels can be attributed primarily to the following factors: (1) material/geometric coupling; (2) strength/stiffness anisotropy; (3) multiplicity of failure modes (matrix and fiber dominated); and (4) time-dependent effects. In general, the following two approaches are taken for arriving at an optimal configuration for composite flywheels: (1) thickness is held constant and material properties are varied and (2) for a given set of material properties, thickness is varied with the radius (an additional design parameter is the outer to inner radius ratio). The variation of either the material properties or the thickness is obtained from an optimality criterion. Two such criteria are: (1) hoop strength controls rotor failure and (2) simultaneous failure in both hoop and radial failure modes.

THERMAL

REFER ALSO TO CITATION(S) 5627, 5628, 5629, 5630, 6040

5985 (CONF-771203—, pp 809-810) **Thermoeconomic analysis of thermal energy storage.** Li, K.W. (North Dakota State Univ., Fargo). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5986 (CONF-771203—, pp 811-813) **Experimental study of thermal energy storage by use of reversible chemical reactions.** Fujii, I.; Tsuchiya, K. (Meiji Univ., Kawasaki, Japan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5987 (CONF-771203—, pp 815-817) **Experimental investigation of a fused salt energy storage system.** Banerjee, S.; Hodgins, J.W.; Kim, J.D.; Shewchun, J. (McMaster Univ., Hamilton, Ont.). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5988 (CONF-771203—, pp 831-833) **Direct contact heat exchange for latent heat of fusion storage systems.** Nichols, M.C.; Green, R.M.; Bramlette, T.T. (Sandia Labs., Livermore, CA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5989 (CONF-771203—, pp 835-837) **Moving bed heat transfer for advanced energy applications.** Thornton, T.A.; Schluderberg, D.C. (Babcock and Wilcox, Lynchburg, VA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

5990 (LBL—7066) **Summary of current studies in aquifer thermal energy storage.** Tsang, C.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1978. Contract W-7405-ENG-48. 14p. (CONF-780443—2). Dep. NTIS, PC A02/MF A01.

From 2. conference on alternate energy; Palm Springs, CA, USA (8 Apr 1978).

Recently there has been renewed interest in the possibility of using underground aquifers for the storage of hot or chilled water. This concept has been seen as a way of remedying the time mismatch between supply and demand periods, one of the major problems facing the design of total energy systems and the development of solar energy. The present paper reviews current studies in this area, with emphasis on the work being performed at the Lawrence Berkeley Laboratory. The physical basis of the concept lies in: (1) the low thermal conductivities of caprock and bedrock materials; (2) the large volume of the aquifer (of the order of 10^7 m^3); and (3) the capability of storing water under high pressures. Earlier studies involved the general formulation of the idea and various calculations. Recent work includes numerical modeling and practical field tests.

5991 Heat storage method and apparatus. Ashe, T.L. (to The Garrett Corp.). US Patent 4,089,176. 16 May 1978. Filed date 20 Jan 1976. 10p.

A method and apparatus for operating power turbomachinery is described. The method consists of an electromagnetic induction heated, graphite heat storage core adapted to heat compressed fluid for subsequent expansion across a fluid turbine to generate rotary mechanical power output.

CHEMICAL

REFER ALSO TO CITATION(S) 5508, 5986, 6131

5992 Process for the conversion, conveyance, and utilization of energy. Cocuzza, G.; Beghi, G. (to Societa Italiana Resine S.I.R. S.p.A.). US Patent 4,091,864. 30 May 1978. Priority date 13 May 1975, Italy. 6p.

An energy conversion, conveyance and utilization system is described for providing process heat in industrial plants, which makes use of a source of heat such as a nuclear reactor to dissociate sulfur trioxide according to the reaction: $2SO_3$ reversible arrows $2SO_2 + O_2$, the dissociation products being conveyed through a pipeline to a remote utilization station where the heat of the recombination is utilized, the resulting sulfur trioxide being returned through the pipeline to the reactor site. The pipeline incorporates separate pipes in which the sulfur dioxide and sulfur trioxide are conducted in liquefied form, surrounded by a duct in which the gaseous oxygen flows.

BATTERIES

REFER ALSO TO CITATION(S) 4990, 5370, 6029

DESIGN AND DEVELOPMENT

5993 (CONF-7710171—1) **Commercialization planning for the lithium/metal sulfide battery.** Chilenskas, A.A. (Argonne National Lab., IL (USA)). 1977. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From Symposium on lithium needs and resources; Corning, NY, USA (12 Oct 1977).

A federally supported battery development program has been underway at Argonne National laboratory since 1973 that is directed to the development and commercialization of high-energy batteries that meet national needs. This program has received a high national priority from the Energy Research Development Administration (and previously the Atomic Energy Commission) with appropriate R and D funding because achievement of the program goals is perceived as having a potentially important impact upon the energy resources in the U.S. The commercial production of high-energy-density batteries, if produced at costs that are attractive, can result in the reduction of petroleum consumption in applications such as utility peak-shaving or personal transportation. This would be accomplished by shifting these applications away from petroleum-fueled combustion turbines and internal combustion engines to battery peaking plants for utilities and battery-powered automobiles which can use electricity produced from energy sources such as coal or nuclear fuel. The energy storage that is projected for mature lithium/metal sulfide (Li/Ms) batteries is about 4 to 5 times that of today's lead—acid battery per unit weight and about 3 to 4 times per unit volume. Achievement of these performance goals and the cost goals for the cells of $20 to $35/kWh would make this system very attractive for many applications of commercial interest. 4 figures, 5 tables.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 6245

5994 Rechargeable silver—zinc batteries. Horowitz, C.; Dichter, M. (to Polymer Research Corp. of America). US Patent 4,091,193. 23 May 1978. Filed date 31 Mar 1977. 4p.

The evolution of hydrogen in rechargeable silver—zinc batteries is reduced by the incorporation into the zinc electrode of a minor proportion of a lead oxide, e.g., either lead oxide (PbO) or lead dioxide (PbO_2). The invention further relates in general to electrodes for batteries, the electrodes consisting mainly of zinc oxide and having distributed through them.

5995 Method and apparatus to recharge a battery aboard an electric vehicle. Nguyen, P.D. (to Societe de Traction Cem-Oerlikon). US Patent 4,091,319. 23 May 1978. Priority date 23 Jan 1976, France. 6p.

A method and an apparatus to recharge a power supply aboard a vehicle which is driven by one or more electric traction motors are described. The motors are capable of being fed by the power supply aboard the vehicle or by an exterior power supply source through an energy-regulating circuit aboard the vehicle. The energy-regulating circuit is utilized to feed the electric traction motors and to recharge the power supply aboard the vehicle. The energy-regulating circuit operates at a constant rate, whereby the energy not absorbed by the one or more electric traction motors is utilized to recharge the power supply aboard the vehicle. A command circuit is associated with the energy-regulating circuit to assure that the energy-regulating control circuit has a constant current output.

APPLICATIONS

REFER ALSO TO CITATION(S) 5513, 5995

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 4989, 5345, 5469, 5474, 5501, 5569, 6395, 7138

5996 (CONF-7706129—) **1977 AIPE annual convention proceedings.** (American Inst. of Plant Engineers, Cincinnati, OH). 1977. vp. TIC.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

A separate abstract was prepared for each of ten papers in the conference proceedings; eleven were not in scope for the DOE Energy Data Base. Also, a separate abstract was prepared for each of 3 sessions (papers grouped and presented at two general sessions and one special session). All of the abstracts were selected for Energy Research Abstracts (ERA); 8 were selected for Energy Abstracts for Policy Analysis (EAPA). (MCW)

5997 (CONF-7710136—) **Proceedings of the fourth annual UMR-DNR conference on energy. Theme: energy crisis; where do we go from here. Volume 4.** Morgan, J.D. (ed.). (Missouri Univ., Rolla (USA); Missouri Dept. of Natural Resources, Jefferson City (USA)). 1977. 718p. University of Missouri, Rolla, MO.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

The theme of the conference was Energy Crisis: Where Do We Go from Here. The keynote speech was given by Commissioner Richard T. Kennedy of the U.S. Nuclear Regulatory Commission and entitled "The Energy Crisis: The Challenge for Nuclear Regulation." A separate abstract was prepared for each of the seventy-nine papers included in the proceedings. All abstracts will be included in Energy Research Abstracts (ERA); 67 were selected for Energy Abstracts for Policy Analysis (EAPA). (MCW)

5998 (CONF-7710136—, pp 181-186) **Survey of energy-information systems and its implications for industrial energy management.** Omurtag, Y.; Sineath, H.H.; Wiebe, H.A. (Univ. of Missouri, Rolla). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

There is a need for state governments to prepare better strategic plans dealing with the use of their energy resources. These plans must be based on reliable information concerning energy resources and usage if they are to make a contribution to sound energy management. This paper presents the results of a survey conducted during 1976 and 1977 to determine the availability of comprehensive energy information systems for planning and controlling the state-wide energy-related activities in the United States.

5999 (DOE/EIA—0036-1) **Annual report to Congress, 1977. Volume I.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 112p. (CRN—780-131-00041; SP-AN—74/A(77)(Vol.1)). Dep. NTIS, PC A06/MF A01.

The Energy Conservation and Production kAct (ECPA)(P.L. 94-385) established the Office of Energy Information and Analysis within the Federal Energy Administration (FEA). Two chief purposes served by this action were: to support policy and program needs by developing a central, unified, and comprehensive program to provide statistical support and analytical services to the FEA and to provide, more widely, energy data, information, and statistical series to the Congress, the Administration, State and local governments, and the general public. Under this legislation, the Office of Energy Information and Analysis (OEIA) was formally created on January 11, 1977. It was comprised of three major suboffices headed

by Deputy Assistant Administrators. They were the Offices of Data Services, Data and Analysis, and Economic Impact Analysis. This report for calendar year 1977 recounts the experience of OEIA whose lifetime extended from January 11 to September 30 of that year, and then takes up the first 3 months' experience of a successor organization which came into being with the activation of the Department of Energy. In the ECPA, the Congress established a permanent body, the Professional Audit Review Team (PART), to maintain a continuing overview of the operations of the OEIA, and to report annually to the Congress. The first PART report pointed to a number of areas in which improvement was needed. EIA found the report to be generally fair and insightful, and from the report identified a number of significant tasks as ones to largely form EIA's work agenda for the year 1978. Work began on all of these, and substantial progress in the course of 1978 is anticipated. The first EIA Annual Report is issued in three volumes. Volume I is historical and gives an account of the work of the two agencies during the year. (MCW)

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 6005, 6013, 6021, 6041, 6052, 6053, 6054, 6055, 6056, 6057, 6058, 6093, 6094, 6095, 6102, 6105, 6176, 6196

6000 (CONF-771042—, pp 27-32) **Exploratory data analysis and classical statistics: their abilities to shed light on energy issues.** Mayer, L.S. (Princeton Univ., NJ). Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

Exploratory data analysis and classical statistics are compared in terms of their potency for the analysis of major energy issues. First, the positions of the two approaches in the contemporary philosophy of science are considered. The relevance of these positions to the major energy issues is developed. Then a set of guidelines for the use of exploratory data analysis on energy data is presented. Finally, the exploratory and classical approaches are compared by using each to estimate the price elasticity of residential natural gas. The analyses suggest those areas in which each approach is most useful.

6001 (LA—7462-PR) **Energy systems and statistics. Progress report, January—March 1978.** Snyder, E.A. (comp.). (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract W-7405-ENG-36. 29p. Dep. NTIS, PC A03/MF A01.

In the statistical analysis realm, the staff formed a data base for the Plainview, Texas, quadrangle and began subsequent analysis; additional programs were written to provide uranium concentration histograms for given latitude and longitude boundaries; a considerable increase was noted in the number of shipper-receiver forms processed for the nuclear accountability program; the cervical cancer cell sample study reached a stalemate; and the staff neared completion in its appraisal of LASL's utilities and equipment. Numerous papers were completed and presented to professional organizations during this quarter. Topics included offshore oil and gas leases, computer graphics, Chernoff Faces, and transformations of the multivariate normal distribution. In addition, the staff published reports on such topics as gas reservoirs, gas-water reservoirs, evolutionary distance and secondary structure for biomolecules, and the probability distribution of bids for oil and gas leases on the outer continental shelf. In this same vein, a movie on modeling a gas-water reservoir was also completed. The Energy Systems staff delved into passive solar systems for individual family dwellings; visibility studies related to coal-fired power plants; a redesign of the Regional Comparative Analysis program; a broadened use of the GMAPS system; the problem of increased coal traffic for a Wyoming town; and water-related problems associated with increased energy development. The final reporting questionnaire for the inventory of energy-related data bases, etc., also was completed during the quarter. And a report on energy development and Indian lands, a topic of great concern in the West was drafted and readied for circulation.

6002 (UCRL—52519) **Computer code documentation for the Livermore Economic Modeling System.** Rousseau, W.F.; Rambo, J.T.; Castleton, R.N.; Sussman, S.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jul 1978. Contract W-7405-ENG-48. 34p. Dep. NTIS, PC E03/MF E01.

The Livermore Economic Modeling System (EMS) is a package of computer codes for constructing, solving, and presenting results from general equilibrium economic models. To be used with other documentation on EMS and on the Livermore Energy Policy Model (EPM), this report provides additional information for the programmer who must maintain the codes or convert them to another installation. A brief overview is presented on each code. Interactions between codes are defined and key internal data and file structures are described in detail. Practical information on compiling and debugging changes is provided. Included also on microfiche is a complete program listing with extensive comments.

6003 (UCRL—52526) **User's manual for the Livermore Economic Modeling System.** Rambo, J.T.; Coles, B.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Jul 1978. Contract W-7405-ENG-48. 98p. Dep. NTIS, PC A05/MF A01.

Analysts and programmers in the Energy and Resource Planning Group at the Lawrence Livermore Laboratory have developed an Economic Modeling System (EMS) consisting of software and a special input language for representing markets and economic processes and solving for market-clearing prices and quantities. EMS is the foundation of the Livermore Energy Policy Model (EPM), which is now being used to analyze the effects of governmental policies on the energy sector of the U.S. economy through the year 2025. This manual was prepared for the EMS user who wishes to run his own calculations and for the production assistant who needs to understand the procedures for maintaining EMS. The names, locations, functions, and execute lines of each of the EMS programs are given, together with examples of the format of input and output files. EMS was designed for a CDC 7600 computer.

6004 (UCRL—52527) **Economic models and algorithms used in the Livermore Economic Modeling System.** Rousseau, W.F.; Sussman, S.S.; Castleton, R.N.; Rambo, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Aug 1978. Contract W-7405-ENG-48. 41p. Dep. NTIS, PC A03/MF A01.

This report presents the economic models and equation solution methods built into the Livermore Economic Modeling System (EMS). Networks, microeconomic models, solution by iteration, and simulation of government-imposed constraints are all discussed. Microeconomic models are described in great detail in nomenclature similar to that used in the data set. References to other EMS reports are included.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 6002, 6003, 6004, 6016, 6022, 6073, 6096, 6099, 6167, 6174

6005 (ANL/EES-TM—9) **Framework for comparative analyses of socio-economic impact: CASE-I.** Stenehjem, E.J.; Baldwin, T.E.; Metzger, J.E.; Dixon-Davis, D. (Argonne National Lab., IL (USA)). Dec 1976. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02/MF A01.

This report describes a technical framework under development for projecting changes in major socio-economic parameters as a consequence of energy development. The parameters forecasted by the CASE-I framework include annual changes in the base or natural population of the area by age, sex, and race; employment due to energy development; natural population and employment due to energy development; the migration of new households to (and from) the various jurisdictions within the impact area; and public service needs within the jurisdictions of the impact area. These projects can be provided by county for any of the 3188 counties in the continental United States, and within each county, for the impacts of eight different energy technologies, including: strip and in-situ mining facilities; offshore oil and gas facilities; nuclear power facilities; coal-fired electric generating facilities; oil shale conversion facilities; coal gasification facilities; and geothermal facilities. This framework, though computerized, is not referred to as a model since it is a collection of interdependent modules which permit (and even require) extensive user interaction. Its purpose is to permit users to evaluate, with relative ease, the timing and magnitude of socio-economic changes expected from energy development. As such, CASE-I should prove to be of significant value to local officials in areas expecting some form of energy activity.

6006 (CONF-771203—, pp 771-772) **Function of economics in energy policy.** Zelby, L.W. (Univ. of Oklahoma, Norman). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6007 (CONF-7710136—, pp 108-114) **Life-cycle costing of energy systems.** Baker, W.R. (Univ. of Wisconsin, Madison). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Determination of true costs of ownership and the proper evaluation of savings are extremely important with regard to the

purchase of energy-efficient systems. It is the purpose of this paper to discuss the application of the life-cycle costing process as applied to the evaluation of capital expenditures.

6008 (HCP/M8696—01) **Making the most of energy in real estate: relevant energy facts for real estate developers, builders, lenders, appraisers, and brokers.** Isakson, H.R.; Kushner, D.D. (Georgia Univ., Athens (USA)). Apr 1978. Contract EC-77-C-01-8696. 427p. Dep. NTIS, PC A19/MF A01.

The following chapters are included: government energy policies, production and energy consumption, the energy future, understanding energy conservation in real estate, thermal comfort and design principles, measuring and improving the energy efficiency of existing structures, environmental control systems, solar energy, investment analysis, and guidelines and aids for making the most of energy in real estate. (MHR)

6009 (HCP/M8696—03) **Instructor's manual to accompany "Making the most of energy in real estate".** Isakson, H.R.; Kushner, D.D. (Georgia Univ., Athens (USA)). Apr 1978. Contract EC-77-C-01-8696. 25p. Dep. NTIS, PC A02/MF A01.

This instructor's manual includes suggested programs, presentation techniques, lesson outlines for the chapters, review and discussion questions and answers, and recommended field trips. (MHR)

6010 (UCRL—13886(Pt.1)) **SRI national energy model: revisions of data base and resource curves.** Short, W.D. (SRI International, Menlo Park, CA (USA)). Apr 1978. Contract W-7405-ENG-48. 72p. Dep. NTIS, PC A04/MF A01.

The information provided LLL in the development of a generalized equilibrium model (GEM) of energy supply and demand in the US required the revision and updating of SRI data bases and resource curves. The updates to the SRI National Energy Model include modifications to the economics of primary resource recovery, energy conversion, and transportation and modifications to the demand for end-use energy. Resource costs are broken down into capital and operating costs, which required restructuring the marginal cost curves for coal, oil, and gas within the US.

6011 (Y/OWI/SUB—78/22336/P2) **Resolving community conflict in the nuclear power issue.** Burt, R.S. (Union Carbide Corp., Oak Ridge, TN (USA). Office of Waste Isolation). May 1978. Contract W-7405-ENG-26. 69p. Dep. NTIS, PC A04/MF A01.

This is the second of a two-part discussion the purpose of which is to demonstrate that a frankly structural, or network, approach to the analysis of community decision-making allows an observer to anticipate and manage community response to specific policies. Using the siting of nuclear facilities as an illustrative policy, Part One (Burt, 1978) derived hypotheses predicting what types of communities could be expected to become embroiled in conflict over a proposed facility and the process that conflict escalation would follow. The purpose here is to extend the argument to include conflict resolution. Available research is analyzed in order to outline a structural approach to the resolution of community conflict over specific policies. The conflict-resolution techniques proposed are intended to reverse the social parameters of conflict escalation and compensate for deficiencies in a community structure so as to transform a community high in potential for conflict into a community with low conflict potential. The discussion concludes with general principles for the resolution of community conflict in the nuclear power issue.

6012 **Effects of railroad abandonment on the modal distribution of traffic and related costs.** Weinblatt, H. (Jack Faucett Associates, Chevy Chase, MD); Matzzie, D.E.; Harman, J. *Transport. J.;* **17**: No. 4, 86-96(Sum 1978).

The Railroad Revitalization and Regulatory Reform Act of 1976 (4R Act) and other recently enacted legislation contain provisions that can result in increased rates of abandonment by railroads of unprofitable branch lines, as well as provisions that will permit subsidies for continued service on many of these lines. The purpose of this legislation, of course, is to improve the financial health of the currently ailing railroad industry. However, any increase in the rate at which branch-line service is terminated can be expected to have side effects on the rest of the transport industry, on the present users of affected lines, and on the local economies of the predominantly rural areas served by these lines. This paper summarizes the results of a recently completed study, which had the objective of providing information about the extent of some of these effects. In particular, estimates are developed of the potential effects of railroad abandonment on: the freight-transport system; transport costs of affected rail users; resulting public-sector and private-sector investment requirements; and energy consumption. Four sets of lines were identified that had either recently lost rail service or that could lose service in the future. These sets were designated as: excluded lines, abandoned lines, lines with petitions pending, and apparently uneconomic lines.

6013 **Price uncertainty and the exhaustive firm.** Burness, H.S. (Univ. of Kentucky, Lexington). *J. Environ. Econ. Manage.;* **5**: No. 2, 128-149(Jun 1978).

In the presence of a resource constraint, the risk-averse exhaustive firm reacts to price uncertainty in a manner different than its competitive counterpart. In particular: (1) some results are independent of attitudes toward risk; (2) comparative statics results differ from the no-resource-constraint case; and (3) results depend upon the relative magnitudes of the discount rate and quasi-fixed costs. An assumption crucial to the relevance of risk-aversion in an intertemporal setting is the presence of imperfections in capital markets (i.e., the absence of complete contingent commodity markets). 19 references.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 5083, 5153, 5218, 6020, 6133, 6174, 6506, 6507, 6508, 6509

6014 (ANL/EES-CP—15) **Environmental development plan update: EHV programmatic environmental assessment; EHV demonstration environmental assessment.** Bernard, M.J. III; LaBelle, S.J. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 31p. (CONF-7806104—1). Dep. NTIS, PC A03/MF A01.

From Electric hybrid vehicle contractors coordinating meeting; Germantown, MD, USA (26 Jun 1978).

The environmental planning and assessment process used by DOE Transportation Energy Conservation (TEC) Division is described, particularly its use in the Electric and Hybrid Vehicle (EHV) Systems Program. For the TEC Division, the major documents that are produced in connection with technology-specific projects are the Environmental Development Plan (EDP), the Environmental Assessment (EA), and the Environmental Impact Statement (EIS) or, conversely a Negative Determination (ND). The EDP is an annual cycle document that is developed in step with the Program Planning and Budget Review cycle of DOE. It covers all the programs in TEC, providing concise descriptions of each project or technology. The major force of the EDP is the analysis of possible or expected environmental concerns that arise from each technology and a determination of the efforts required to mitigate adverse effects, while the technology is still being developed. The need for design modifications is identified before large commitments are made to specific hardware devices, or vehicle or roadway systems. Environmental understanding of the impacts identified in the analysis of the technologies is essential to determining the relative importance of those impacts. This document presents 22 exhibits to describe the process. The 18 TEC technologies in the EHV Systems Program to be assessed are the Stirling and gas turbine engines; constant speed accessory drive system; bottoming cycle for heavy duty trucks; continuously variable transmission; truck turbocompound diesel engine; gas turbines in buses; broad-cut petroleum fuels; alcohol and synthetic fuels; hydrogen; electric and hybrid vehicles; pipeline bottom cycle; medium-speed diesel alternative fuels; coal/oil slurry marine fuels; marine diesel bottoming cycle; and automotive micro carburetor. (MCW)

6015 (ANL/EES-TM—8) **Framework for detailed site-specific studies of local socio-economic impacts from energy development.** Baldwin, T.E.; Dixon-Davis, D.; Metzger, J.E.; Stenehjem, E.J. (Argonne National Lab., IL (USA)). Dec 1976. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

The extraction and/or conversion of energy resources can be expected to proliferate in the immediate future. The socio-economic consequences of the "boom-town" phenomena are pervasive; they impact both energy consumers and producers as well as the indigenous and in-migrating populations of the areas exposed to development. While the effects are potentially more severe on the old and new households in the impact area, the consequences of the social and economic disruptions experienced in "boom towns" are transmitted to the energy producers in the form of higher costs from the declines in productivity attributable to high labor turnover and ultimately to energy consumers in the form of higher prices. Thus, the problems associated with the socio-economic impacts of energy development are properly the responsibility of officials at the Federal, state, and local levels; the energy industry; and consumer advocacy groups. This report describes an analytic approach that can be used to assess the impacts of energy development in site-specific situations and to prepare recommendations for the mitigation of these impacts. The framework presented enables the user to forecast annual changes in the magnitude and composition of employment and population of the impact area, then evaluate the effects of these changes on the provision of needed services specifically and local quality of life generally over time. Thus, while this approach permits an analysis of future growth due to energy development, its primary concern is to evaluate the site-specific implications of growth and

possible strategies for their mitigation. The framework outlined here has been applied to the case of a single coal gasification facility in Mercer County, North Dakota. The results of that study are summarized here to illustrate the nature of the analysis, the types of conclusions, and the variety of mitigating strategies obtainable from the use of this framework.

6016 (CONF-7706129—, pp 50-80, Addendum) **Environmental/energy trade-offs: paradox and problems.** 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

In an addendum to the proceedings of the 1977 annual convention of the American Institute of Plant Engineers, the general session on June 21 consisted of comments from 4 speakers with Raymond Cline, acting as moderator. Environmental/energy tradeoffs were discussed by U.S. Rep. Bill Corcoran from the legislative standpoint; by Russel H. Susag in a paper entitled, "Pollution Prevention Pays"; by Maurice B. Tobin in a paper entitled, "A National Energy Policy—Proposition and Reality"; and finally, a paper by Jack Ravan, Environmental Protection Agency, from an environmentalist's viewpoint. (MCW)

6017 **Environmental Protection Agency research authorization for appropriations for fiscal year 1978. Ninety-Fifth Congress, First Session, House of Representatives, October 19, 1977.** Washington, DC; Environmental Protection Agency (1977). 19p.

A conference report was issued on the amendment of the Senate to the bill (H.R. 5101) to authorize appropriations for activities of the Environmental Protection Agency. The differences between the House bill and the Senate amendment were noted and the substitute agreed to in conference was discussed. The conference report authorized a total of $253,603,000 for the Environmental Protection Agency's environmental research and development program for fiscal year 1978. This compares to a House authorization of $313,064,000 and a Senate authorization of $185,330,000. A significant difference between the House and Senate bills was that that Senate bill does not authorize research under the Clean Air Act. Rather, the Senate carried this authorization separately in the Clean Air Act Amendments of 1977 (Public Law 95-95). For this reason, the conference substitute contains only an additional authorization of $35 million to cover the environmental protection Protection Agency's supplemental appropriations request for fiscal year 1978. The Senate has also included authorization for research, development and demonstration in support of the Safe Drinking Water Act in the bill S. 1528, the Safe Drinking Water Act amendments, and for research, development, and demonstration in support of the Noise Control Act in the bill S. 1511, Noise Control Act amendments. Both of these bills passed the Senate. There was also an authorization for fiscal year 1978 of 45 million for research, development and demonstration related to solid waste contained in the Resource Conservation and Recovery Act (Public Law 94-580) passed in the last Congress.

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 6013, 6067, 6074, 6136, 6144

6018 (CONF-7706129—, pp 1-49, Addendum) **Energy alternatives: now.** 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

In an addendum to the proceedings of the 1977 annual convention of the American Institute of Plant Engineers, the general session on June 20 consisted of comments from 4 speakers. The session, entitled Energy Alternatives—Now, contained Government Energy Development Programs and Their Effectiveness, by Dr. Maxine Savitz, ERDA; Measures To Assure Adequate Electric Power the Next Ten Years, by John K. Carson, American Electric Power Co.; Industry's Energy Role, by Richard L. Aspenson from 3M; and Practical Alternatives for Natural Gas Users, by Ronald F. Winkler from Sutherland, Asbill, and Brennan, Washington, D.C. (MCW)

6019 (CONF-7706129—, pp 81-111, Addendum) **Late, hot, and timely: June 22, 1977.** 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

In an addendum to the proceedings of the 1977 annual convention of the American Institute of Plant Engineers, the general session on June 22 consisted of comments from 3 speakers. H. Harry Phipps, PE, Tampa, Florida, led the discussion with a paper entitled: ASHRAE Standard 100.4P—Energy Conservation in Existing Industrial Buildings. Peter De May talked about the Trans-Alaska Pipeline and some lessons for the future learned from the project in his paper, Lessons for the Future—Oil and Carter. Joseph Mullen, International Coal Association, spoke on The Outlook for Coal and The Carter Plan. (MCW)

6020 (CONF-7710136—, pp 79-84) **Assessing environmental costs of energy procurement.** Alderfer, R.G. (Harland Bartholomew and Associates, St. Louis). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

An ecological approach to the assessment of environmental impact is described, and associated costs of all major phases of energy procurement is presented. The approach is based on identification of services performed and benefits offered by natural and man-modified ecosystems and requires that energy-procurement activities be analyzed in terms of their impact on these services and benefits. A thorough cost assessment (including quantitative and qualitative factors) of alternate energy plans will aid both the selection of the most-desirable alternate and the reduction of unforeseen costs and problems during and after construction.

6021 **Secondary materials and international trade.** Grace, R. (Univ. of East Anglia, Eng.); Turner, R.K.; Walter, I. *J. Environ. Econ. Manage.;* **5**: No. 2, 172-186(Jun 1978).

The paper develops the international trade dimensions of recycling. It begins by outlining the sources of demand and supply that determine the volume, composition, and direction of trade in waste materials. The model is intended to describe factors affecting international flows of any type of secondary material, although its usefulness in an empirical context is restricted in many cases by data limitations and complex lag structures on the supply side. Parts of the model are then applied to the case of waste paper, focusing on observed differences in national recycling rates and the role of trade in reconciling those differences. 11 references.

6022 **Renewable resource management and extinction.** Clark, C.W.; Munro, G.R. (Univ. of British Columbia, Vancouver). *J. Environ. Econ. Manage.;* **5**: No. 2, 198-205(Jun 1978).

Several authors have noted that extinction of a biological resource could be consistent with a policy of maximizing the discounted present value of economic rent. However, the arguments put forward in support of this assertion have hitherto been based on autonomous models. In this note the nonautonomous case, which turns out to be considerably more difficult to analyze, is discussed. 10 references.

6023 **And now: a resources shortage.** Roberts, F. *New Sci.;* **78**: No. 1097, 16-17(6 Apr 1978).

Although the ultimate world supply of minerals is popularly thought to be controlled by geological factors, the actual availability at any particular time is controlled largely by economic factors. Mineral production is a function of investment in exploration, mining, and processing, coupled with research and development. Given the very long lead-time between a decision to explore and actual production from a mineral field, the steadily increasing difficulty of finding deposits in the already well-prospected parts of the world, plus the political barriers to exploration in the undeveloped countries adjustments in supply in response to changes in demand cannot be assumed to be smooth or in phase. The author discusses the definitions of reserves and resources. Recycling and substitution are discussed as panaceas for dealing with depletion problems. These areas were discussed at two meetings: "The Materials Question" organized by the Institution of Mechanical Engineers in London and a meeting held at Oxford by Resources Policy, a journal, both in March 1978. (MCW)

6024 **Advent of a new coal age.** Giesel, H.B. *Glueckauf;* **113**: No. 19, 963-972(6 Oct 1977). (In German).

A general article on the world and W. German energy situation, with estimates of the life of natural gas and oil resources, the likely contributions of nuclear power and power from unconventional energy sources, is presented. Resources of coal are estimated and the gradual replacement of oil and natural gas by coal in certain applications is foreseen. Coal consumption by industry and the domestic consumer is considered, but the main consumer will be the electricity supply industry; new technologies for producing gas and liquid fuel from coal are seen to be developing. The impact on coal mining itself is also examined.

6025 **Energy, metals, and ores in France for the year 1976.** *Ann. Mines;* **183**: No. 9-10, 11-180(Sep 1977). (In French).

This paper presents a panorama of the problems concerning energy (coal, hydrocarbons, gas, electricity, uranium), metals (aluminium, copper, tin, steel, nickel, lead, zinc) and ores (chromium, manganese, tungsten, phosphates, potash, sulfur, fluorspar). Although mainly concerned with France, the problems are evaluated

within a world wide framework. Numerous tables of statistics are given.

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 6001, 6017, 6030, 6041, 6059, 6083, 6084, 6089, 6506, 6507, 6508

6026 (DOE/IA—0001) **International bilateral and multilateral arrangements in energy technologies.** (Department of Energy, Washington, DC (USA). Office of International Affairs). Jul 1978. 55p. Dep. NTIS, PC A04/MF A01.

This document, the second report in the series, outlines current DOE international commitments under bilateral and multilateral arrangements, as of January 1, 1978. Included are bilateral agreements for cooperation in the civil uses of atomic energy with countries and international organizations, bilateral and multilateral technical exchanges in all energy technology areas, and multilateral agreements under the auspices of the International Energy Agency (IEA). In addition to outlining the terms, scope, and status of these agreements, this document describes DOE's participation in the work of the major international energy organizations. IEA, the International Atomic Energy Agency (IAEA), and the Nuclear Energy Agency (NEA). Future reports will update the status of ongoing cooperative projects and provide information on new energy R and D activities.

6027 (DOE/PR—0010) **Guide for the submission of unsolicited proposals.** (Department of Energy, Washington, DC (USA)). Jul 1978. 32p. Dep. NTIS, PC A03/MF A01.

Organizations and individuals are encouraged to originate and submit imaginative and innovative research or investigations related to the DOE mission or which will assist in the development and the conservation of efficient and reliable energy sources. This guide sets forth the procedures and criteria governing awards based on unsolicited proposals. Types of research supported, invention proposals, writing the proposal document, who may submit, and consultation meetings with the DOE are discussed. When, where, and what to submit are also discussed in Part I. Part II reviews and evaluates the procedure followed by additional information on research in an appendix. (MCW)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 5308, 5311, 5317, 5319, 5365, 5834, 5837, 5838, 5839, 5840, 6011, 6026, 6109, 7090

6028 (CONF-7706129—, pp 8p, Paper 1) **Clinch River Breeder Reactor and energy independence.** Anderson, J.C. (Oak Ridge Associated Universities, TN). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

Nuclear energy with special emphasis on the Clinch River Breeder Reactor (CRBRP) program is discussed. The CRBRP is an important demonstration project in that it will produce electricity and make fuel. For every twelve atoms of fuel utilized to produce heat/electricity, twelve new atoms of fuel will be manufactured. This demonstration will point toward a method of "manufacturing" fuel at a time when naturally-occurring fossil fuels and uranium-235 are being depleted by an ever increasing number of countries each year. Both fossil and uranium-235 fuels are limited. As these finite fuel supplies vanish, it is important that additional energy sources be developed.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 5981, 6040, 6100

6029 (CONF-7710136—, pp 64-70) **Current state-of-the-art of electrochemical batteries from a users point of view.** Wolter, J.G.; Gilbert, J.A.; Leonard, J.V. (McDonnell Douglas Corp., St. Louis). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

This paper presents a description of some of the battery types (couples) on the market, energy densities, and recycle lives. The possibility that some of these could be used in the transportation industry is explored. Speculation of future battery development is discussed.

6030 (DOE/CS—0046) **Electric and hybrid vehicle demonstration, 1978.** (Department of Energy, Washington, DC (USA)). 1978. 15p. Dep. NTIS, PC A02/MF A01.

More and more attention is focusing on electric and hybrid vehicles (E and HVs) as a timely transportation alternative. The increased attention to E and HVs has been sparked by an active DOE program, which is designed specifically to advance E and HV technology and demonstrate market potential. The DOE Program was authorized by Congress through the Electric and Hybrid Vehicle Research, Development, and Demonstration Act (Public Law 94-413) passed on September 17, 1976. In passing the Act, Congress recognized that transportation is today the critical part of the energy crisis. Nearly 54% of the more than 18 million barrels of oil consumed domestically each day is used to move people and goods. If the costly consumption of energy by the transportation sector is to be reduced, alternatives must be developed. One alternative is the gradual introduction of E and HVs for some heat engine vehicle uses. The aim of this brochure is to contribute to public understanding of a major segment of the DOE program.

6031 (TID—28798) **Program plan for development of compressed air energy storage technology.** Lewis, L.G.; Sather, N.F. (Argonne National Lab., IL (USA)). Mar 1976. Contract W-31-109-ENG-38. 53p. Dep. NTIS, PC A04/MF A01.

The Compressed Air Energy Storage (CAES) Program Plan describes in detail the planned activities and expected accomplishments in the conduct of CAES technology development and validation envisioned in the 1976—1990 time frame. The objectives of the mission analysis of CAES are: to assess the cost-effectiveness of CAES in electric utility applications; to determine the market-capture potential of CAES; to determine the energy resource savings obtainable through the deployment of CAES technology; and to guide R and D of CAES technologies by specifying key performance criteria for market acceptance. The Mission Analysis is divided into the following task areas: evaluation of region-specific CAES development potential, including cost analyses for specific sites; estimation of future utility demand for off-peak energy storage systems; estimation of the market-capture potential of CAES, including estimation of associated energy resource and capital savings; and specification of key CAES cost/performance criteria for market acceptance. (MCW)

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 5668, 5705, 6148

6032 (ANL/ICES-TM—4) **Integrated Community Energy System (ICES) commercialization case studies. Volume I. Direct economic and energy analysis of ICES concepts.** Kennedy, A.S.; Lee, C. (Argonne National Lab., IL (USA)). Jan 1978. Contract W-31-109-ENG-38. 147p. Dep. NTIS, PC A07/MF A01.

This study specifically considers the Fox Valley Center and Villages, a new planned community located in Aurora, Illinois. The systems chosen for study were considered representative of three characteristic states of technology: (1) existing, (2) emerging, and (3) advanced. The principal reason for selecting systems in each state was to identify commercialization problems in applying each type of system in a real-world setting. Each system chosen for study is described and evaluated in detail in Appendix B. ICES alternatives studied are: existing technologies (diesel prime mover with waste heat recovery and cool prime mover-variable extraction turbine); emerging technology (unitary and applied heat pump systems); and advanced technology (fuel-cell prime mover with waste heat recovery). The systems analyzed fall into two categories: (1) decentralized, single building, customer-owned systems connected to grid energy, and (2) centralized, on-site, multi-building ICES energy generation and distribution facilities disconnected from grid energy except possibly for fuel supplies or peaking electrical power. In each category, existing and emerging technologies have been analyzed, and comparisons of options among categories have been made. (MCW)

6033 (ANL/ICES-TM—11) **Assessment of the potential for district heating in four major eastern cities: Washington, D.C., Philadelphia, Baltimore, and Boston.** Bernow, S.S.; Rosen, R.A. (Energy Systems Research Group, Inc., Albany, NY (USA)). Aug 1978. Contract W-31-109-ENG-38. 109p. Dep. NTIS, PC A06/MF A01.

This study assesses the potential functional and economic advantages of district-heating systems for providing the heating, cooling, and hot-water energy needs of Washington, D.C., Philadelphia, Baltimore, and Boston. Thermal energy demand, demand coefficients, and costs of thermal energy using conventional systems are considered. Finally, the design of district-heating systems is dis-

cussed in terms of distribution networks, costs, and payback from fuel savings.

6034 (ANL/ICES-TM—13) **Test case for the potential application of district energy systems using thermal energy cogenerated at existing electric power plants.** Santini, D.J.; Davis, A.A. (Argonne National Lab., IL (USA)). Jan 1978. Contract W-31-109-ENG-38. 48p. Dep. NTIS, PC A03/MF A01.

District Energy Systems (DES) for providing heating and cooling to Washington, D.C., by utilizing co-generated electrical and thermal energy from existing power plants are examined. The results of two different but related studies are compared. The more conservative of the two studies is given greatest attention. In this study, Washington is divided into four different DES service areas. These service areas are compared to one another for relative DES economic viability. The DES economics and efficiency is also compared to (1) electricity from coal, (2) oil from liquefied coal, and (3) utility gas from coal. Results of this study indicate that DESs for heating are the most efficient of the four supply options. Both studies conclude that the heating costs of DESs are less than heating with electricity when electricity is generated exclusively for heating purposes. The cost comparisons with other heating alternatives are inconclusive but they do indicate that heating by DES may be the most economical in some urban locations.

6035 (CONF-7706129—, pp 11p, Paper 12) **Industrial in-house power generation.** Gordon, J. (Grumman Aerospace Corp., Bethpage, NY). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

The feasibility of installing in-house power-generation systems is considered. Almost all central generating stations convert fuel into power at a range of 30 to 40 percent efficiency. The remainder is rejected to the surrounding environment, both wasteful and harmful. Many industrial sites are capable of recovery of much of the waste heat for use in heating, cooling, and process lines. Typically, the conversion to steam in existing, but modified boilers can reduce or eliminate the need to manufacture separately fueled steam. Thus, a company usefully extracting over 70 percent of the energy content of fuels will usually benefit financially and benefit the nation through energy conservation. A thorough economic analysis must be performed for each industrial site and the unique conditions surrounding it. The electric/heat energy seasonal requirements coupled with a utility and fuel cost spectrum that may vary with time of day and season will dictate the best type of total energy system. Diesel engines, gas turbines, and steam turbines are all viable prime movers with heat extraction from water jackets, exhaust stacks, and multiple stage steam extraction methods of heat recovery. Demand, steam capacity, capital life and depreciation, operating parameters, condition of existing electric and steam systems and ability to reuse them, tax and interest rates, backup requirements, land and building availability, are some of the major parameters to be compared and summarized for determination of feasibility and profitability of such a step.

6036 (COO—2477-015) **Preliminary study of large cogeneration/district heating power plants.** Pavlenco, G.F.; Englesson, G.A.; Hu, M.C. (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Mar 1978. Contract EY-76-C-02-2477. 109p. Dep. NTIS, PC A06/MF A01.

The concept of cogeneration is receiving national attention as a measure of energy conservation, for cogeneration increases the ratio of useful energy output to the energy input of a steam-electric power plant. The heat energy supplied by way of steam can be used for both industrial processing and district heating. In the latter case, the steam is used either directly as a heat carrier or indirectly for heating the water recirculated in hot-water district-heating systems. This study is centered on a condensing cogeneration turbine with four controllable steam extractions at two different pressure levels 6 to 13 psia and 10 to 29 psia) so that the water used for district heating is heated in two stages in series. When the heat load demand is small, steam can be further expanded in the condensing tails downstream from the controllable extractions, thereby enabling a certain degree of independence between the production of heat and electric power. This cycle is especially suitable when the heat load varies considerably during the year, as is the case for district-heating requirement. Currently, there are no large cogeneration facilities and the intent of this study is to prepare a preliminary technical and economic assessment of an 800-MWe condensing cogeneration turbine for hot-water district heating. The study includes: (1) a review of the basic principles of cogeneration; (2) the conceptual design of an 800-MWe cogeneration plant cycle; and (3) the comparison of cogeneration and conventional electric power plants of equal rated capacity in terms of heat rate, fuel savings, and cooling-water consumption. Technical and economic areas that need extensive and detailed evaluation are identified. The ultimate goal is to establish the utility criteria for a prototype large district heating/electricity system in the USA. (MCW)

6037 (COO—4211-2) **Grid-connected Integrated Community Energy System. Preliminary report, Phase II, August 9—November 8, 1977.** (Clark Univ., Worcester, MA (USA)). 1977. Contract EC-77-C-02-4211. 141p. Dep. NTIS, PC A07/MF A01.

Clark University in the New England area represents an attractive site for demonstration of cogeneration. In Phase I of the program, the team reported: that the system of choice is a diesel generator sized at about Clark's peak electric demand; it should burn No. 6 fuel oil; the system can run at nearly full capacity the year round, sell 40 percent of its output, and receive backup as needed from Massachusetts Electric Company; the system should deliver a rate of return of 15 to 20 percent; and there appear to be no institutional or environmental problems. An update on a number of issues that were incompletely resolved in the Phase I report is provided. In Section 2 additional documentation on institutional issues involved in the proposed demonstration plant is provided. In Section 3 a preliminary design analysis that clearly defines the choice of engine and provides revised operating data in light of additional load profile studies is provided. In particular, it is found that: a Sulzer No. 6-oil-burning 1405-kW diesel is the system of choice; the engine should be housed in a separate building in close proximity to the existing central boiler and steam distribution points; and as a result of detailed summer load studies, the engine as specified can be operated with higher capacity factors than anticipated in Phase I. In Section 4 a revised cost estimate using information developed in Sections 2 and 3 is given. No significant change in net cash flow was found, and there was an internal rate of return of 15 percent. The overall conclusion is therefore that, though some details have changed, the Clark demonstration project continues to appear highly attractive. (MCW)

6038 **Utility industrial energy center.** Hunt, H.H. (Eugene Water and Electric Board, OR). pp 123-125 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

A local electric utility and an industrial customer, Weyerhaeuser Company, join in a relationship to utilize existing boilers and process steam requirements to also produce electric energy for the utility at a fuel-conversion efficiency of 81%. The utility will own and install the turbine-generator on leased land within the mill site and also pay for certain modifications to the existing boiler facilities. The rationale of both parties in entering into the contracts, their responsibility, obligations, ownership, financing, operations, maintenance, and fuel arrangements are discussed.

6039 **District heating in Finland. Carrying out calculations of profit for heat supply.** Jauhiainen, I. (Buero Kommunale Energieversorgung, Helsinki (Finland)). *Fernwaerme Int.;* 7: No. 2, 54-57(May 1978). (In German).

The article tells how to carry out investigations to solve problems in connection with optimum energy supply in communities as the author's institution does. The problem discussed in this paper pertain to rentability determinations in the introduction of district-heating systems.

CONSERVATION

REFER ALSO TO CITATION(S) 5996, 6007, 6018, 6019, 6034, 6036, 6037, 6065, 6094, 6097, 6103, 6107, 6108, 6145, 6158, 6161, 6163, 6164, 6175, 6182, 6183

6040 (ANL/EES-TM—15) **Cost and performance of heat-pump-TES and solar-TES household energy systems.** (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Mar 1977. Contract W-31-109-ENG-38. 106p. Dep. NTIS, PC A06/MF A01.

In order to understand the various possibilities and roles thermal energy storage (TES) can play in household energy systems, Argonne National Lab. has studied the engineering performance and economics of such systems. This phase of the study concentrates on the use of TES in conjunction with solar-augmented and heat pump residential energy systems that provide hot water, space heating, and space cooling. The overall effort is directed towards evaluating the interaction of these systems with electric utilities in terms of costs and benefits to both the utility and the consumer. This interaction depends on the system's overall design, performance, and cost characteristics. This evaluation covers the three basic household energy services that lend themselves to thermal energy storage: hot water, space heating, and space cooling. The systems are evaluated individually; however, it is more likely that final design could be integrated to achieve a more-effective system. The exception to this is the heat pump, which is generally sized to handle the cooling load, although

it also supplies heating capacity. The solar systems are augmented by an electric utility. The systems are designed to minimize their impact on the utilities load-management problems by use of a TES subsystem. The study evaluates these systems for a single-family dwelling unit, although it is recognized that systems for multiple dwelling units are often technically and economically more viable. Detailed evaluations of hypothetical future systems for which there is little basis to perform an economic evaluation are not included in this report. They will be considered in an assessment of R and D alternatives in the final study report. A summary evaluation is made, however, of the characteristics of some advanced TES subsystems, in order to illustrate how much improvement they would offer over the baseline systems.

6041 (BNL—50839) **Use of the pulp and paper industry process model for R and D decision making.** Pilati, D.A.; Rosen, R. (Brookhaven National Lab., Upton, NY (USA)). Mar 1978. Contract EY-76-C-02-0016. 22p. Dep. NTIS, PC A02/MF A01.

A regional pulp and paper industry process model was used to assess the maximal market-penetration of new energy-conservation technologies for that industry under various energy-price assumptions. This linear-programming optimization model was used to calculate the systemic impacts on the industry of each technology separately, and as a group. The attractiveness of various co-generation technologies derived from the model was also evaluated with and without an investment tax credit. These were compared to the market penetration levels estimated in a report prepared by Resource Planning Associates, Inc. The implication of the model runs for R and D funding decision making within the DOE Division of Industrial Conservation was discussed.

6042 (CONF-7706129—, pp 7p, Paper 4) **Electric demand controllers: are they really effective.** Peterson, K.C. (S and C Electric Co., Chicago). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

The effectiveness of electric demand controllers is discussed in general by considering the following questions—do all controllers operate on the same general principle; do they all reduce demand; are utility bills reduced; do all utilities welcome their use. The author concludes that some controllers presently available will create at least two major problems for utilities: load peak splitting and "roller coaster" load characteristics. These problems can be overcome either by modifying controllers to operate on a principle independent of the utilities timing interval or by having the utility modify its demand-measuring methods. The most practical solution would be to use controllers that measure the demand either on a thermal principle or a floating-interval principle. An alternate solution would require the utilities to change to the thermal or floating-interval method of measuring demands. The thermal-demand method has been discontinued by utilities for many years. The floating-interval method is available with the use of magnetic tape recorders and appropriate computer-processing equipment to search out the interval with the highest demand consumption (MCW)

6043 (CONF-7706129—, pp 12p, Paper 5) **Computerized building management and control for maximum energy conservation.** Jen, D.P. (IBM, Atlanta). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

This paper describes the centralized computer-based energy and facilities management system being implemented for the 11-story headquarters building of the IBM General Systems Division in Atlanta. There are two primary objectives of this system: (1) to manage and control building utilities operation to minimize energy usage and labor cost; and (2) to provide on-line alarms and guidance to assist fire safety and security operations. The system is designed to continuously monitor, control, and provide equipment scheduling to best match the HVAC capacity to actual building cooling and heating loads to minimize wasteful energy usage on a dynamic basis. As the system performs key functions such as maximizing equipment startup, time-of-day equipment start/stop, peak-power-demand control, dynamic adjustment of process variable set point such as supply air temperatures, outside air damper position, chilled-water temperatures and hot-water temperature, it also monitors location and status alarm points on a conventional life safety system as well as those points of a specially designed building security system.

6044 (CONF-7706129—, pp 8p, Paper 19) **ASHRAE, Standard 90-75: an overview.** Gupton, G.W. Jr. (Gupton Engineering Associates, Inc., Atlanta). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

In June, 1973, the ASHRAE Standards Committee was asked to investigate the need for energy conservation standards in buildings. Menawhile, the National Bureau of Standards (NBS) began preparing a document on design criteria for new buildings. Then the National Conference of States on Building Codes and Standards (NCSBCS) asked the ASHRAE Board of Directors to consider writing a consensus standard on energy conservation using the NBS document as the basis for the standard. In February, 1974, ASHRAE agreed to write the standard and a project committee was established for ASHRAE Standard 90P. The final document was approved by the ASHRAE Board of Directors on August 11, 1975. The 11 sections of Standard 90-75 are reviewed here. Shortly after completing Standard 90-75, ASHRAE set forth on a new standards program to cover energy conservation in existing buildings. Six proposed areas for the new 100-series designation will include low-rise residential, high-rise residential, commercial, industrial, institutional, and public assembly. (MCW)

6045 (CONF-7710136—, pp 124-132) **Conserving energy and protecting environment by using freight pipelines: a technology assessment.** Liu, H.; Gibson, D.L. (Univ. of Missouri, Columbia). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The freight pipeline is not just a possibility but a reality. It is an emerging new mode of transportation that has many advantages such as energy conservation and environmental protection. The paper discusses the state-of-the-art of this new technology. 16 refs.

6046 (CONF-7710136—, pp 150-159) **Operator's guide for minimizing energy costs.** Dare, C.E.; Gerig, F.A. Jr. (Univ. of Missouri, Rolla). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The consumption of petroleum by transportation activities is increasing despite the finite limits on its supply. This paper concentrates on the motor vehicle driver, his driving habits, and guides to reduced fuel consumption, which would enable the individual to curtail wasteful practices with respect to vehicle operation.

6047 (CONF-7710136—, pp 168-173) **Methodology for evaluating the effectiveness of energy-conservation programs.** Eckerlin, H.M. (North Carolina State Univ., Raleigh). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

With increasing Federal emphasis on energy and its conservation, programs to conserve energy are being proposed at all levels of industry, commerce, and government. Many of these programs promise results that can never be realized. This paper describes an operational methodology for estimating and measuring energy savings for these energy-conservation programs. The assumptions and qualifications that form the basis of the methodology are discussed, and some techniques for interfacing the methodology with a company's energy-conservation program are presented.

6048 (CONF-7710136—, pp 174-180) **Emerson Electric: application and results of an electric energy audit.** Jacobs, B.E. (Emerson Electric Co., St. Louis); Omurtag, Y. 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The study examines the electrical usage of an Emerson division located in the Northeast, provides a method of managing the usage, and makes recommendations for conservation. Both past and present usage were examined in an attempt to determine if potential savings might be realized by a reduction in energy and peak demand. Discussion will include an electrical energy-tracking mechanism, ratios and indicators, use of rate consultants, state sales tax exemption clauses, and sample calculations of cost improvements on demand charges.

6049 (COO—4248-6) **Passenger-car fuel economy in short-trip operation.** Phoebe, C.H. (Gulf Research and Development Co., Pittsburgh, PA (USA)). 30 Apr 1978. Contract EC-77-C-02-4248. 66p. Dep. NTIS, PC A04/MF A01.

Benefits that could be attained from a gasoline blended to provide improved short-trip fuel economy are assessed, approached with two goals in mind: (1) develop a test procedure to effectively evaluate any method that shows promise for improved fuel utilization; (2) use the procedure to obtain a better understanding of what is needed in present-day gasoline to improve short-trip economy. The short-trip cycle is a 3-stage test starting with the vehicle at ambient conditions and repeating a 0.685-mile-cycle ten times as the vehicle warms up. The vehicle is stopped for ten minutes. This is

followed by the first 505 seconds of the EPA driving schedule commonly referred to as the hot transient run, or the 1975 Hot Run. At this time, the vehicle is considered to be fully warmed up, and the initial cycle is repeated three times. The factorial test design was used to compare typical seasonal fuels with a special fuel developed to better establish the effect of fuel gravity on fuel economy. Two operating temperatures, 0 and 90°F, were used. The fuel effect was evaluated in small cars and in large cars and with standard carburetion and fuel injection. The four cars used in the program were a Cadillac Seville with fuel injection, an Oldsmobile Delta 88 with carburetion, a Volvo 245 DL with fuel injection, and a Ford Pinto with carburetion. The study estimates that an improvement of 1% in fuel economy during the first five miles will effectively reduce our annual gasoline consumption by 200 to 300 million gallons. (MCW)

6050 (DOE/CS—0041/2) **Energy audit workbook for schools.** (Department of Energy, Washington, DC (USA)). Sep 1978. 84p. Dep. NTIS, PC A05/MF A01.

This workbook describes some simple methods by which the administrator, maintenance manager, or operator of a school can analyze energy uses, determine areas in which energy savings can be made, and estimate the magnitude of cost savings in accordance with U.S. Department of Energy procedures described as Class C Information Audits. It provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for schools that do not have full-time engineering personnel. Of necessity, it is a generalized approach which cannot be as detailed as an energy audit conducted by an engineering team. Although this workbook emphasizes the energy-intensive processes and some of the recognized areas of energy waste in schools, it should be used selectively because each building has its unique energy-use patterns.

6051 (DOE/CS—0041/3) **Energy audit workbook for hospitals.** (Department of Energy, Washington, DC (USA)). Sep 1978. 99p. Dep. NTIS, PC A05/MF A01.

This workbook describes some simple methods by which the administrator or maintenance director of a hospital can analyze energy uses, deterine areas in which energy savings can be made, and estimate the magnitude of cost savings in accordance with U.S. Department of Energy procedures described as Class C Information Audits. It provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for hospitals that do not have full-time engineering personnel. Of necessity, it is a generalized approach which cannot be as detailed as an energy audit conducted by an engineering team.

6052 (DOE/CS—0041/4) **Energy audit workbook for hotels and motels.** (Department of Energy, Washington, DC (USA)). Sep 1978. Contract EM-77-C-01-8693. 101p. Dep. NTIS, PC A06/MF A01.

The workbook provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for hotels and motels which do not have full-time engineering personnel. Briefly, the procedure involves assembling energy-consumption data for the past 12 months; checking on the building's geographic location and site conditions; reviewing the building's description to understand its basic construction; and listing the heating plant, air-conditioning equipment, electrical equipment, and lighting-system fixtures that are controlled by a member of the personnel. This information provides a base for implementing the maintenance and operational changes and energy-conservation measures that will make the building as energy-efficient as possible. Chapter 1 provides suggestions for measures that may be performed without cost to increase the building's present energy efficiency. (MCW)

6053 (DOE/CS—0041/5) **Energy audit workbook for die casting plants.** (Department of Energy, Washington, DC (USA)). Sep 1978. 81p. Dep. NTIS, PC A05/MF A01.

In a typical die-casting plant, it is possible to save as much as 15% of utility costs through common-sense actions without any appreciable capital expenditure. The workbook provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for die-casting plants that do not have full-time engineering personnel. Energy-conservation measures that demand no capital investment are: reduce the preheat time for molds and furnaces to the minimum required; preheat charge metal by storing on top of the furnaces; not over-fire; adjust the length of the mold preheater pilot flame to a minimum; lower the thermostats in the office area during the heating season; make the monthly energy consumption and cost data available to the manager and chief operating engineer; turn off stand-by furnaces that aren't absolutely necessary; lower the domestic hot water to 105°F; and adjust burners to operate at the best efficiency. Measures that have shown a dramatic savings for the least initial investment are: design dies to minimize the amount of metal in the sprues and gates; cover hot stand-by crucibles with insulating covers; install electric ignitors at casting stations to eliminate the large gas pilot flames; put insulated covers on charging ports to cut down the radiation losses; if practical, use exhaust gas heat to preheat inlet air or to heat hot water; if you use a boiler for space heating, have a technician check the efficiency; use energy conserving fluorescent lamps; control exterior lighting with photo electric cells; preheat combustion air where practical; and if you are being penalized by the electric company for a low power factor, it may be cost-effective to correct it.

6054 (DOE/CS—0041/6) **Energy audit workbook for office buildings.** (Department of Energy, Washington, DC (USA)). Sep 1978. 95p. Dep. NTIS, PC A05/MF A01.

In a typical office building, it is possible to save as much as 15% of utility costs through common-sense actions without any appreciable capital expenditure. This workbook describes some simple methods by which the owner or manager of an office building can analyze energy uses, determine areas in which energy savings can be made, and estimates the magnitude of cost savings in accordance with U.S. Department of Energy procedures described as Class C Information Audits. The workbook provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for office where management does not have access to a full-time engineering staff. Of necessity, it is a generalized approach that cannot be as detailed as an energy audit conducted by an engineering team. Although this workbook emphasizes the energy-intensive processes and some of the recognized areas of energy waste in office buildings, it should be used selectively because each building has its unique energy-use patterns.

6055 (DOE/CS—0041/7) **Energy audit workbook for restaurants.** (Department of Energy, Washington, DC (USA)). Sep 1978. 79p. Dep. NTIS, PC A05/MF A01.

In a typical restaurant, it is possible to save as much as 15% of utility costs through common-sense actions without any appreciable capital expenditure. This workbook describes some simple methods by which the owner, manager, or operator of a restaurant can analyze energy uses, determine areas in which energy savings can be made, and estimate the magnitude of cost savings in accordance with U.S. Department of Energy procedures described as Class C Information Audits. The workbook provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for restaurants that do not have access to an engineering staff. Of necessity, it is a generalized approach that cannot be as detailed as an energy audit conducted by an engineering team. Start the energy audit of your restaurant by assembling energy-consumption data for the last 12 months, making yourself aware of your restaurant's geographic location and site conditions, and having your restaurant's description at hand. Next, list the heating plant, air-conditioning equipment, electrical equipment, and lighting fixtures that are controlled by you, the restaurant's owner or manager. These systems are the biggest energy users in a restaurant, and you will want to understand them to help identify means of making them more efficient with the aid of this workbook.

6056 (DOE/CS—0041/9) **Energy audit workbook for warehouses.** (Department of Energy, Washington, DC (USA)). Sep 1978. 95p. Dep. NTIS, PC A05/MF A01.

In a typical warehouse, it is possible to save as much as 15 percent of utility costs through common-sense actions without any appreciable capital expenditure. The workbook provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for warehouses. After discussing general maintenance and energy conservation measures that demand no capital investment, measures are listed that have been shown to produce dramatic savings for the least initial investment: replace old, inefficient burners with new, efficient ones; have a technician check the efficiency of the boiler on a regular basis; install loading dock door seals; insulate hot, bare heating pipes; repair or replace leaking steam traps; where practical, use waste heat for hot-water heating; control exterior lighting with photoelectric cells; preheat combustion air where practical; use energy-conserving fluorescent lamps; and if you are being penalized by the electric company for a low power factor, it may be cost-effective to correct it. (MCW)

6057 (DOE/CS—0041/10) **Energy audit workbook for bakeries.** (Department of Energy, Washington, DC (USA)). Sep 1978. 89p. Dep. NTIS, PC A05/MF A01.

In a typical bakery, it is possible to save as much as 15 percent of utility costs through common-sense actions without any appreciable capital expenditure. Many bakery operators do not realize that it might be possible to close the dampers down on the oven. Most oven dampers can be closed down until condensation or fume blowout occurs. One bakery realized a savings of $13,000 per year by closing down the oven dampers to the minimum. You should be able to close down the dampers without incurring any initial cost. Another energy-saving measure that is quite practical to the baking industry is preheating the combustion air to the oven burners. Providing hot air for combustion is much more efficient than drawing cold air from the surroundings. To preheat the combustion air several bakeries have installed heat exchangers in the exhaust gases. Energy savings

of 3 to 4 percent are feasible. Energy-saving measures in the lighting system and HVAC system are indicated.

6058 (DOE/CS—0041/11) **Energy audit workbook for retail stores.** (Department of Energy, Washington, DC (USA)). Sep 1978. 77p. Dep. NTIS, PC A05/MF A01.

In a typical store, it is possible to save as much as 15 percent of utility costs through common-sense actions without any appreciable capital expenditure. This workbook provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for retail stores that do not have full-time engineering personnel. Of necessity, it is a generalized approach that cannot be as detailed as an energy audit conducted by an engineering team. General maintenance and operational changes requiring no investment that will result in energy conservation are: lowering the thermostats during the heating season and raising them during the cooling season (about 8 percent of heating fuel bill can be saved by lowering the thermostats five degrees); examining the entire building for air leaks around windows, doors etc. and sealing the leaks; removing unnecessary lights; making the monthly energy consumption and cost data available to the manager and chief operating engineer so that they can evaluate and compare against previous months and normal budget; involving the employees in the goals of energy conservation; and shutting off or removing heating units from vestibules, lobbies, and corridors. (MCW)

6059 (DOE/CS—0047) **Technology and Consumer Products Branch: program plan.** (Department of Energy, Washington, DC (USA). Office of Building and Community Systems). Sep 1978. 43p. Dep. NTIS, PC A03/MF A01.

The Technology and Consumer Products Branch (TCP) activity is a major thrust of the Division of Buildings and Community Systems program, and includes Development and Demonstration (D and D) activities in energy conservation that accelerate the efforts of private industry; complement the efforts of private industry; foster the acceptance of energy saving technology; maximize the effectiveness of energy use; and minimize adverse socio-economic and environmental impacts. The broadly stated objective of the TCP Branch is to encourage and manage new energy-conserving technologies for which a market exists in heating, cooling, and ventilating equipment and systems; lighting and windows; appliances; building controls; diagnostic equipment used to determine the efficiency of energy use in buildings; and other consumer products. It has been estimated that 33 percent of the nation's yearly energy production is used in buildings. The TCP Branch has divided its program into three areas: (1) the development of more energy-efficient technologies, (2) the development of energy-efficient consumer products, and (3) the analysis of and dissemination of information about these technologies and products. Summaries are given for the Headquarters Programs, ORNL Programs, Brookhaven National Laboratory Programs, and Lawrence Berkeley Laboratory Programs in these areas.

6060 (HCP/M4288—01) **Twin Rivers program on energy conservation in housing: highlights and conclusions.** Socolow, R.H. (Princeton Univ., NJ (USA)). Aug 1978. Contract EC-77-C-02-4288. 86p. Dep. NTIS, PC A05/MF A01.

Key results and conclusions of a field study of residential energy use, now in its sixth year, are reviewed. The research is being undertaken in a setof nominally identical townhouses in Twin Rivers, New Jersey, a recently built community of standard construction with gas space heating, electric central air conditioning, and a full set of appliances. Average levels of energy consumption and their dependence on weather and building type have been established, thereby permitting detailed quantitative studies of the sources of remaining variability. Starting from this baseline, the authors established the level of change in energy consumption that followed the "energy crisis" in the autumn of 1973 and performed two kinds of controlled experiments: (1) experiments where a set of modifications (retrofits) were made to the building structure, and (2) experiments where "feedback" was provided to residents on a regular basis, reporting their level of consumption of energy. Conclusions drawn from modeling and experimentation are presented here, with emphasis given to those results bearing directly on the character of programs to retrofit the national housing stock. Photographs and graphical displays of data are provided.

6061 (HCP/M8656—08) **Resource file: practical publications for energy management. A reference guide to handbooks, curricula, and audiovisual materials.** (JRB Associates, Inc., McLean, VA (USA)). Mar 1978. Contract EL-76-C-01-8656. 319p. Dep. NTIS, PC A14/MF A01.

This file is an in-depth bibliography of action-oriented energy-conservation publications. It is a reference tool, designed for anyone who is asked to recommend "how-to" conservation guides to the public, or who wishes to select one for himself. Managers, facility engineers, building owners and operators, staff-development coordinators, consumer-affairs professionals, architects, educators, extension agents, librarians, and technical information specialists are among those who will find this an extremely useful guide to the literature of energy conservation. The Resource File is an expanded version of Practical Materials for Teaching Energy Management: A Resource File, Edition I, first published by the Department of Energy in the fall of 1977. The entries are short reviews, developed in sufficient detail to permit the user to choose the manuals, study guides, films, and pamphlets best suited to his specific needs. Each listing describes a publication's intended audience and provides a chapter-by-chapter summary of its contents. Entries close with a brief reviewer comment, including accession information. Section I describes primary references, those which can be used alone as practical guides to energy conservation. Included here are operations and maintenance manuals, life-cycle costing handbooks, home insulation manuals, films on fuel-saving driving techniques, and courses devoted exclusively to home weatherization. Section II reviews supplementary material which can be used to add technical and theoretical depth to planning and executing a conservation project, or to preparing educational courses and materials.

6062 (MHSMP—78-51) **Vanpooling at Pantex Plant.** Thompson, M.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Sep 1978. Contract EY-76-C-04-0487. 11p. Dep. NTIS, PC A02/MF A01.

From National ridesharing conference; Baltimore, MD, USA (18 Sep 1978).

The concept of the privately owned and operated method of vanpooling (specifcally at the Pantex Plant) is discussed. The author instigated the first vanpool and he relates his experiences with financing and insurance and relates how the program has widened. He sums what vanpooling has done for Pantex and the nation as a whole: at Pantex, 30 vans save 240,000 gallons of gasoline per year; 300 parking spaces are gained; employees arrive on time and are rested; and 400,000 miles of accident free travel per year are negotiated. Pantex has initiated a program to produce vanpools in many other industrial areas. (MCW)

6063 (SAN—1225-T010-1) **Investment risk evaluation techniques: use in energy-intensive industries and implications for ERDA's Industrial Conservation Program.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 13 Jul 1977. Contract EY-76-C-03-1225-010. 121p. Dep. NTIS, PC A06/MF A01.

The trade-off between risk and rate-of-return in investment evaluations is crucial in assessing the commercial potential of future energy-conservation technologies. The focus of the Industrial Conservation Program at ERDA is to reduce the perceived risks of a given technology to the extent that the private sector will adopt the technology within the normal course of its business operations. These perceived risks may emanate from technical, institutional, or commercial uncertainties, or in many cases they may result merely from a company's or industry's lack of previous experience with a particular technology. Regardless of the source of the risk surrounding a project, the uncertainty it poses to the private sector will serve to inhibit decisions to invest. This study evaluates the treatment of risk in capital investments in certain energy-intensive industries which are the primary targets of ERDA's Industrial Conservation Program. These risks evaluation considerations were placed within a context that includes capital budgeting practices and procedures, organizational considerations, and basic rate-of-return evaluation procedures in the targeted energy-intensive industries (petroleum, chemicals, paper, textiles, cement, food processing, aluminum, steel, glass, and agriculture).

6064 (TID—28399) **Report of the proceedings of the Department of Energy workshop on energy conservation in agricultural production, October 31 and November 1, 1977.** (Washington Scientific Marketing, Inc., DC (USA)). 1977. Contract W-31-109-ENG-38. 64p. Dep. NTIS, PC A04/MF A01.

The Industrial Energy Conservation Division of the Department of Energy held a workshop on "Energy Conservation in Agricultural Production" on October 31 and November 1, 1977. The two day workshop was planned as a follow-up to a previous workshop on Agricultural Production in July, 1976. Six discussion groups were formed and covered the following subjects: crop production systems, animal production systems, on-farm processes, fertilizers and pesticides, water resources, and use of agricultural by-products. Participants speaking were asked to center their remarks on evaluating and reviewing the projects listed in the July, 1976 report; refining and identifying the areas which require further study; listing the necessary resources for each project; recommending priority rankings; and evaluating the Department of Energy's programs. (MCW)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 5428, 6010, 6026, 6087, 6090, 6091, 6094, 6105, 6176, 7182

6065 (ANL/ICES-TM—14) **Review of energy demand and conservation scenarios in the residential and commercial sectors.** Robbins, C. (Florida Agricultural and Mechanical Univ., Tallahassee (USA)). Aug 1978. Contract W-31-109-ENG-38. 62p. Dep. NTIS, PC A04/MF A01.

This study reviews and summarizes existing data on energy demand, within the framework of geographical regions and specific residential or commercial building types, for the time frames of 1980 to 1985, 1985 to 1990, 1990 to 2000. It reviews and summarizes a variety of proposed energy conservation scenarios, applies each scenario to the energy consumption data for each time frame, and establishes the amounts of energy conserved by each scenario. It establishes a base energy demand model for specific residential or commercial building types within each geographical region. These base models could then be used in conjunction with existing steady-state energy demand models to help ascertain energy conservation strategies for individual buildings. Specific assumptions that apply to energy demand, construction variables, or conservation scenarios are outlined in separate Residential, Commercial, and Conservation Scenario Sections of this study. (MCW)

6066 (BNL—50863) **Energy demand analysis in the workshop on alternative energy strategies.** Carhart, S.C. (Brookhaven National Lab., Upton, NY (USA)). Apr 1978. Contract EY-76-C-02-0016. 44p. Dep. NTIS, PC A03/MF A01.

The Workshop on Alternative Energy Strategies, conducted from 1974 through 1977, was an international study group formed to develop consistent national energy alternatives within a common analytical framework and global assumptions. A major component of this activity was the demand program, which involved preparation of highly disaggregated demand estimates based upon estimates of energy-consuming activities and energy requirements per unit of activity reported on a consistent basis for North America, Europe, and Japan. Comparison of the results of these studies reveals that North America requires more energy per unit of activity in many consumption categories, that major improvements in efficiency will move North America close to current European and Japanese efficiencies, and that further improvements in European and Japanese efficiencies may be anticipated as well. When contrasted with expected availabilities of fuels, major shortfalls of oil relative to projected demands emerge in the eighties and nineties. Some approaches to investment in efficiency improvements which will offset these difficulties are discussed.

6067 (CONF-771175—, pp xiii-xxv) **Banquet address.** Pestel, E. Jul 1978.

From Symposium on alcohol fuel technology; Wolfsburg, F.R. Germany (21 Nov 1977).

In Proceedings of the international symposium on alcohol fuel technology: methanol and ethanol.

The necessity for a global assessment of the energy problem and of a global response, especially from the industrialized nations, is emphasized. The growth of the energy demand in the German Federal Republic is projected. The capital expenditures that will be required from the Republic and from the other industrialized nations in order to develop alternative energy sources are estimated. In conclusion, institutional and political difficulties in the implementation of a global energy policy are indicated. (JSR)

6068 (CONF-780802—7) **Analysis of demand for paper products.** Nguyen, H.D.; Knight, P. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From American Statistical Association meeting; San Diego, CA, USA (14 Aug 1978).

Empirical demand models characterized in terms of aggregate annual observations of economic magnitudes necessarily subsume variation in those economic magnitudes. The variation is of two types: variation across individual micro units (cross-sectional variation) and variation due to periodization differences in the aggregate magnitudes (infra-annual variation). Much has been written about both types of variation. Virtually nothing, however, in the literature relates infra-annual variation to the annual aggregate magnitude although hints of the effect of such variation have been made in the case of electricity demand. A theory is proposed in this paper which links annual magnitudes to their infra-annual variation and opens up a new dimension in annual time series characterizations of (in this case) demand. The theory is tested against annual observations of electricity demand from two large utility systems and the corresponding hourly observations from which the annual observations are derived.

6069 (DOE/EIA—0036/2) **Annual report to Congress, 1977. Volume II. Projections of energy supply and demand and their impacts.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1978. 346p. (CRN—780-328-00127; SP-AN—74/A(77)(Vol.2)). Dep. NTIS, PC A15/MF A01.

The Federal Energy Administration Act of 1974 and the Energy Conservation and Production Act (ECPA) of 1976 both require that the Energy Information Administration (EIA) (as a successor to the Federal Energy Administration) prepare forecasts of energy supply and demand and consumption in the short, medium, and long term, and that the EIA maintain a technical capacity for such forecasting. This volume is responsive to those legislative requirements. Forecasts for the mid term and short term have been made under six sets of assumptions. These reflect five combinations of possibilities relating to economic activity between now and 1990 and the quantities of undiscovered, recoverable resources of gas and oil in the United States; all five of these assumption combinations also presuppose constant world oil prices over that era in constant dollars. The sixth forecast case chooses a central one of the five previous cases, combined with an assumption of rising real world oil prices. Thus, in the main, the mid-term forecasts provide six more or less plausible possibilities, and so convey to the user some indication of plausible uncertainties attaching to the estimates. Forecasts were included for oil, gas, coal, the nuclear fuel cycle, electricity, and new and emerging technologies (synthetic fuels, geothermal and solar energy, wind energy and photovoltaic conversion, and solar thermal conversion). (MCW)

6070 (DOE/EIA—0036/2(Ex.Summ.)) **Annual report to Congress, 1977. Volume II.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1978. 25p. (CRN—780418-00171; SP-AN—74/A(77)(Vol.2)(Ex.Summ.)). Dep. NTIS, PC A02/MF A01.

Volume II of the Energy Information Administration's (EIA) Annual Report was prepared in response to legislative requirements of the Federal Energy Administration Act of 1974 and the Energy Conservation and Production Act (ECPA) which call for analyses and preparation of energy consumption and supply trends and projections under various assumptions and a summary or schedule of the amounts of energy resources and fuels that can be brought to market at various prices. The findings are summarized here. (MCW)

6071 (DOE/EIA—0036/3) **Annual report to Congress, 1977. Volume III. Statistics and trends of energy supply, demand, and prices.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 150p. (CRN—780-501-00182; SP-AN—74/A(77)(Vol.3)). Dep. NTIS, PC A07/MF A01.

With the mission and purpose of the EIA clearly set forth in the DOE Organization Act, the Administration began its existence on October 1, 1977, incorporating energy information programs and personnel from the FEA, FPC, and the Bureau of Mines (BOM) of the Department of the Interior. This compendium of statistical charts and tables is the third, and final, volume of the first Annual Report to Congress of the Energy Information Administration. The information all relates to the past; there are no projections in this volume. The topics that are treated deal with U.S. national energy statistics, especially supply, demand, and price. International energy matters appear only as total imports of energy to the United States. Data are compiled on oil, gas, coal, petroleum products, nuclear energy, geothermal energy, solar energy. (MCW)

6072 (LBL—7937) **Using computer-assisted cartography to map the U.S. energy system.** Drysdale, F.R.; Wood, P.M.; Calef, C.E. (Brookhaven National Lab., Upton, NY (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 14p. (CONF-780749—1). Dep. NTIS, PC A02/MF A01.

From Harvard computer graphics week conference; Cambridge, MA, USA (23 Jul 1978).

Most descriptions of the United States energy system are aggregated to the state or national level, and are usually in prose, tabular, or flow-chart form. To improve our understanding as to where fuels are produced and used, and the effects of the U.S. energy system, a computer-generated atlas of several energy-related variables was produced for the country using the county as the basic mapping unit. Existing computer-mapping software was used by users new to the computer center as well as the software to produce color maps vividly displaying the heterogeneity of the U.S. energy system.

6073 (ORAU/IEA—78-15(R)) **Guide to price elasticities of demand for energy: studies and methodologies.** Edmonds, J.A. (Institute for Energy Analysis, Oak Ridge, TN (USA)). Aug 1978. Contract EY-76-C-05-0033. 139p. Dep. NTIS, PC A07/MF A01.

This paper reviews recent theoretical and empirical research into the effects of energy prices on energy demand. It is found that (1) energy prices do matter: higher prices promote conservation, other things constant, though increasing affluence tends to discourage energy frugality; price is only one of many important factors; (2) no consensus as yet exists on the exact magnitudes of elasticities: aggregate energy demand does appear to be inelastic, although individual fuel types generally have higher elasticities than the aggregate; (3) interfuel substitution is an important source of re-

sponse: consumer responses are more pronounced when a specific fuel price changes than when all fuel prices change together; and (4) adjustment time is important: the longer consumers have to adjust to a given change in price, the more conservation one expects. Important areas for further study still exist. These include building energy demand model structures developed from an even stronger theoretical basis. Specifically, either indirect utility or production function foundations are necessary, as is a theoretical framework based on the underlying motivations for lagged demand adjustment. In addition, greater regional and sectoral detail is necessary in energy modeling, along with richer and better data.

6074 World energy situation: a study of the Exxon Corporation looks at the year 1990. *Oel;* **15**: No. 4, 90-98(Apr 1977). (In German).

An Exxon study, examining the prospects, until 1990, of keeping the world outside the communist sphere supplied in energy, foresees the serious danger of shortages, lack of flexibility and failures to make political decisions in good time. All these factors represent dangers to the general economic development.

6075 Waiting for the wolf. Eden, R.J. *Coal Energy Q.;* No. 10, 8-14(Aut 1976).

The author outlines the energy options facing the world and the U.K. For the world as a whole, difficulties in meeting increments of energy supply after 1990 could be eased by conservation measures if initiated without delay. In the case of the U.K., in order to offset energy imports that might put the country at a disadvantage against other trading nations in the 1990s, indigenous production levels should be maintained. North sea oil and gas lead, however, to special problems of choice between short-term options. Tables show world and U.K. energy-supply scenarios up to the year 2000.

6076 Proceedings of the twelfth space congress. Technology today for tomorrow. Cape Canaveral, FL; Canaveral Council of Technical Societies (1975). vp. (CONF-750422—). $21.25.

From 12. space congress; Cocoa Beach, FL, USA (9 Apr 1975).

Twenty-nine papers were presented at the conference. A separate abstract was prepared for each of 4 papers. One paper was previously processed for the data base. (MCW)

6077 Energy survey: what can R and D do by 1985. Copps, S.L. (National Aeronautics and Space Administration, Washington, DC). pp 5.19-5.27 of Proceedings of the twelfth space congress. Cape Canaveral, FL; Canaveral Council of Technical Societies (1975).

From 12. space congress; Cocoa Beach, FL, USA (9 Apr 1975).

The results are described of an informal survey performed by NASA within its own agency to determine if any R and D activities might be an exception to the general rule of long lead times and thus have significant impact by 1985 on oil and natural gas consumption. The study was limited to only include suggestions which could save oil and natural gas and which would require a level of R and D to be accomplished. These include R and D required in the areas of (1) increasing the supply of: (a) oil from shale and secondary and tertiary recovery techniques, (b) coal, from advanced deep mining techniques and environmentally acceptable surface mining techniques; (2) energy recovery from wastes through gasification or by burning; (3) increased use of nuclear energy; (4) bulk storage to relieve the need for peaking power; (5) increasing the utilization of high sulfur coal through stack gas scrubbing or fluidized beds; and (6) production of synthetic fuels from coal. Results show a potential for large savings in oil and natural gas in many areas. The area of transportation appears to have the greatest potential (with the least amount of government involvement). The residential and commercial sector also has a high potential for savings. The area of reduced consumption by substitution does not appear to have much potential. The suggestions listed in this area will probably require an unacceptable level of government investment to be accomplished.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 4942, 5104, 5105, 5106, 5153, 6016, 6041, 6067, 6135, 6166, 6174

6078 (CONF-771042—, pp 175-183) **Panel discussion.** Hooper, R.L. (Pacific Northwest Lab., Richland, WA); Bennett, C.A.; Kouts, H.J.C.; Leone, F.C.; Tukey, J.W. Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

Most of the decisions in formulating a national energy policy have been heavily impacted by consideration in areas such as health effects, nuclear reactor safety, and nuclear materials safeguard. Each of these areas is almost a macrocosm in statistics in that each involves measurement problems, data problems, modeling, and evaluation. The panel first discussed roles of the statistician and decisions needed and formulated in national energy policy. Then the subjects covered were: the need to understand the problems to the point that they can be articulated in a meaningful way to consumers; and the need to make the application of complicated procedures more credible through the kinds of error analyses and the statements that are associated with them. Panelists were Richard L. Hooper, moderator, Pacific Northwest Labs., Richland, WA; Carl A. Bennett, Battelle, Seattle; Herbert J.C. Konts, Brookhaven National Laboratory; Fred C. Leone, American Statistical Association, Washington, D.C.; and John W. Tukey, Princeton University. (MCW)

6079 Maintaining integrity of structures, systems, and components important to safety during construction of multiunit sites. *Fed. Regist. (Wash., D.C.);* **43**: No. 152, 34764-34765(7 Aug 1978).

From Energy, 10CFR50, Nuclear Regulatory Commission. Domestic licensing of production and utilization facilities.

The Nuclear Regulatory Commission is amending its regulations to require that, for multiunit sites, applicants for construction permits and operating licenses take proper precautions to assure the integrity of structures, systems, and components important to the safety of the operating unit or units during all construction activities. The amendments are being made in response to a petition for rulemaking filed by the Business and Professional People for the Public Interest. A notice of proposed rulemaking inviting public commends was published in the Federal Register on July 14, 1977. The effect of the amendments will be to formalize and clarify specific requirements as they apply to multiunit sites and to codify existing licensing practice. The rule would apply to applications received 6 months after the effective date (September 6, 1978) of the rule.

6080 Use of certain packagings. *Fed. Regist. (Wash., D.C.);* **43**: No. 140, 31138-31139(20 Jul 1978).

From Transportation, 49CFR, Materials Transportation Bureau, Department of Transportation.

The purpose of this rule is to amend various sections of the regulations to authorize the use of certain packagings for specific hazardous materials, to modify the specifications of particular packagings, and to incorporate certain miscellaneous changes. These regulatory actions are intended to remove the constraints imposed on shippers by special permits or exemptions without compromising safety, to authorize general use of specific packagings for certain materials and to simplify and clarify the regulations in order to eliminate the possibility of non-compliance with the regulations.

6081 Preliminary notification of hazardous waste activities. *Fed. Regist. (Wash., D.C.);* **43**: No. 133, 29908-29916(11 Jul 1978).

From Protection of Environment, 40CFR250, Environmental Protection Agency. Preliminary notification of hazardous waste activities.

These proposed rules set forth the procedures for preliminary notification of hazardous waste activities. They define administrative procedures under which States may be granted the authority to receive notifications of hazardous waste activities, and they specify the procedures for filing such notifications by persons conducting hazardous waste activities. The Environmental Protection Agency (EPA) is proposing rules in order to facilitate notification of hazardous waste activities for both those persons who must file notifications and those who will receive them.

6082 Procedures for processing hazardous conditions complaints. *Fed. Regist. (Wash., D.C.);* **43**: No. 131, 29513-29516(7 Jul 1978).

From Mineral Resources, 30CFR43, Mine Safety and Health Administration. Procedures for processing hazardous conditions complaints.

These rules provide procedures for filing and responding to notices given by representatives of miners, or by miners at mines where there are no representatives, that violations of the Federal Mine Safety and Health Act of 1977 or of health or safety standards under the act exist or an imminent danger exists. There is a right to a special inspection if an appropriate notice is given to the Secretary of Labor or his authorized representative. In addition, an informal review procedure is established for refusals to issue a citation or order where the Secretary or his authorized representative has been notified that an alleged violation or imminent danger exists. These rules are issued pursuant to the Federal Mine Safety and Health Act of 1977.

6083 ERDA program for stimulating research and development requirements of Federal energy policy. White, P.C. (Dept. of Energy, Washington, DC). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 371-378(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Discussions are presented concerning ERDA interactions with industry and other agencies in the development of energy conservation plans, solar energy, oil shale, and coal. (JRD)

6084 An academic's view of energy and environment R and D needs and issues in response to Federal energy policy. White, D.C. (Massachusetts Inst. of Tech., Cambridge). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 396-403(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The tendency for ERDA to look to its own laboratories to conduct the major fraction of its R and D poses a challenge that universities must face. In general, it has become standard practice for Federal mission-oriented agencies to follow the in-house laboratory route. To determine the wisdom of this practice, consideration must be given to whether the government's mission can best be served by this process. In the case of energy R and D, there are two major factors that are basic to a careful evaluation of where research activities can best be focused. First, it must be recognized that the commercialization of energy technology will be carried out by private industry; therefore, technology transfer must be easily incorporated into the R and D process. Second, it must be remembered that energy R and D is not simply technology development for new sources or methods of utilization, but it must also include environmental, health and economic issues. It is believed that universities have a natural advantage to meet the multiple objectives that must be addressed and to do so over the long time frame which those issues will require. However, the Federal mission orientation will not go away, nor should it. The universities therefore must address the problem in a more comprehensive fashion using new management structures when necessary. By so doing, it will be possible to meet the Federal mission orientation, train the professionals who make the make the scientific advances and transfer the technology to the ultimate user. In order to make this happen, the universities must be aggressive and imaginative. In addition, the Federal establishment and particularly the new DOE will have to support such efforts, giving universities time to gain experience in developing the necessary comprehensive programs.

6085 Present day energy and coal policy in the EEC. Williams, L. *Ind. Miner.;* **59**: No. 11, 543-544(Nov 1977). (In French).

A summary of the work of the European Commission and of European energy policy is presented. The picture is not encouraging, as cooperation between member states is difficult to obtain.

6086 Few aspects of the Soviet energy policy. Grenon, M. *Rev. Energ.;* No. 296, 40-49(Aug 1977).

This paper discusses Soviet coal reserves and production and predicts that eventually one fifth of underground production will be by hydraulic mining.

6087 Data needs for energy policy assessment. Goldberg, M.D. (Brookhaven National Lab., Upton, NY). *CODATA Bull.;* No. 23, 5-10(May 1977).

From 5. international CODATA conference; Boulder, CO, USA (Jun 1976).

A set of models has been created at Brookhaven National Laboratory to address a variety of energy policy questions. The main thrust of the work has been to explore the impacts—on resources, the economy, the environment, etc.—of the implementation of a very broad range of new technological options in the future energy supply and utilization system of the United States. Within the models, the demand for energy consumption in a given year serves to drive the set of allowed supply technologies, sometimes under constraints, to exactly satisfy the demand. At the heart of the Brookhaven approach is a picture of the national energy system as a network of technological processes and activities through which energy products flow from extraction to consumption. This picture is known as a Reference Energy System (RES) and two views of the RES are shown. To support the modeling and analysis effort, an extensive data base, called the Energy Model Data Base (EMDB), has been developed at Brookhaven to hold the large array of parametric coefficients which characterize each of the technological processes involved in the supply and utilization of energy. The numeric data are stored in the EMDB with full documentation as to their source, quality, etc. and can be extracted and used for many model applications. The models have been used with highly aggregated demand data to compare national scenarios in which various options for modifications of the national energy system in 1985 and the year 2000 were considered; such comparisons have proven very useful in energy R and D policy decision making.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 4941, 6069, 6071, 6072, 6077, 6084

COAL

REFER ALSO TO CITATION(S) 4979, 4980, 5083, 5110, 5144, 5225, 6085, 6086

6088 (CONF-7710136—, pp 115-122) **Competition in national and Appalachian coal markets.** Page, W.P. (West Virginia Univ., Morgantown). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The paper examines concentration ratios for Appalachian coal production and the output behavior of coal—oil merged firms in Appalachia. This preliminary work offers no support for divestiture actions in the case of Appalachian production and certainly no support for horizontal divestiture of coal—oil mergers. On the contrary, Appalachian production appears to be characterized by a high degree of competition.

6089 More basic research needed in coal technology. Thorne, R.D. *Energy User News;* **3**: No. 33, 22(14 Aug 1978).

Basic research on coal conversion is essential if the U.S. is to utilize its vast resources of coal and, in particular, if Eastern high-sulfur coal is to be used in environmentally sound ways. A coal conversion industry that will have acceptable products in the marketplace by the mid-1980s will require basic research on the molecular structure of coal, the dynamics of coal liquefaction and gasification, the behavior of catalysts during conversion, and the mechanics of methanation. Gaps in engineering knowledge include how to use coal in reactors, how to reduce carbon loss, and how to remove ash. A larger economic data base is also needed before utilities and industry can determine which systems are reliabile and operable. Mr. Thorne, Assistant Secretary for Energy Technology at DOE, believes we should focus on the ultimate customer in planning and funding research programs that will advance the state of coal conversion by looking farther ahead to a clearly defined "third generation technology." A more businesslike approach and more selectivity in the allocation of research and development funds are needed, perhaps with an emphasis on multi-test facilities in the future.

PETROLEUM

REFER ALSO TO CITATION(S) 5158, 5159, 5218, 5219, 6088

6090 (CONF-7710136—, pp 143-149) **National defense aspects of energy imports.** Weatherup, R.A. (Aerospace Engineer, Manchester, MO). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The U.S. is now importing over 46% of its petroleum, over 7,000,000 barrels per day. This paper discusses the adverse effects of these oil imports primarily from an Antisubmarine Warfare (ASW) point of view. In the event of an oil embargo and/or an attack by enemy submarines, there are serious questions as to the U.S. ability to support NATO, or even to sustain an efficient economy.

6091 (DOE/EIA—0076) **Motor gasoline supply and demand 1967—1978.** Seiferlein, K.E. (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 41p. Dep. NTIS, PC A03/MF A01.

Domestic demand for motor gasoline in 1977 was 2.6 billion barrels or 7.2 million barrels per day. The 1977 motor gasoline demand showed an increase of 2.6 percent over the 1976 level, while the demand for total petroleum products increased by 5.2 percent. The historical steady increase in motor gasoline demand was interrupted in 1974 when it dropped by 2.1 percent because of the oil embargo of October 1973 to March 1974. The following year, 1975, motor gasoline demand rose by 2.1 percent putting the rate of demand back at the 1973 level. After reviewing demand factors to 1967, consumption patterns by sectors and supply and demand data are tabulated for 1972-1977. Data on motor gasoline supply (1967-1977) regarding production, imports, and stocks are presented. Forecasts for supply and demand are given for 1978-1979 emphasizing the 1978 DOE forecast. (MCW)

NATURAL GAS

REFER ALSO TO CITATION(S) 5218, 5225, 5238

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 5270, 5271, 5272

ELECTRIC POWER

REFER ALSO TO CITATION(S) 5715, 6042, 6048, 6069, 6071, 6175

6092 (BNL—24149) **Utility load management and solar energy: study background and outline.** Davitian, H.; Bright, R.; Marcuse, W. (Brookhaven National Lab., Upton, NY (USA)). Mar 1978. Contract EY-76-C-02-0016. 17p. Dep. NTIS, PC A02/MF A01.

The large-scale use of electrically-assisted solar heating, hot water, and air-conditioning (solar/electric HHWAC) systems can have a substantial effect on electric utiliities. Under some conditions, peak loads may be increased causing electricity generation costs to rise. This study analyzes the economic, environmental, and social impacts of various rate schedules and load-management strategies governing the use of solar/electric HHWAC systems. Target costs for the solar/electric HHWAC systems are developed, based upon comparison with electric-only HHWAC systems (with a storage option).

6093 (BNL—24627) **Regional Reference Energy Systems: electric utility applications.** Hermelee, A.L. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 21p. (CONF-780843—2). Dep. NTIS, PC A02/MF A01.

From Conference on net energy analysis and energy modeling; Colorado Springs, CO, USA (21 Aug 1978).

Reference Energy Systems have been developed for the region serviced by the Tennessee Valley Authority for the base year 1975 and projections developed for the years 1980, 1985, and 2000. This systems formulation has traditionally been applied to the assessment of energy technologies and policies on a national level. This paper presents a reformulation of the projection methodology in order to apply the Reference Energy Systems format to an electric utility region. The Reference Energy System is a network representation of the technical activities required to supply various forms of energy to end-use activities. Technologies are defined for all operations involving specific fuels including resource extraction, refinement, conversion, transportation, distribution, and utilization. Each of these activities is represented by a link in the network for a given year with the levels of energy demand and supply specified. A unique advantage of using the system presented here for utility planning is its integrative view of the entire energy system as opposed to an analysis limited exclusively to the electric sector. This systems approach incorporating all resources, technologies and uses of energy allows a utility to assess the impact of alternate technologies and policies across the entire energy system. Demand patterns for twenty-five end-use demand categories within the residential, commercial, industrial, and transportation sectors are developed for a base-case scenario representing reasonable energy-use patterns derived in a consistent manner by applying engineering techniques to the best-available information. The impact of a new technology in terms of resource consumption may be evaluated by modifying the energy flow paths to incorporate the new technology. Alternate paths through the network reflect the substitutability of resources and technologies for one another.

6094 (BNL—50757) **Future demand for electricity in the Nassau—Suffolk region.** Carroll, T.W.; Palmedo, P.F.; Stern, R. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA). Inst. for Energy Research). Dec 1977. Contract EY-76-C-02-0016. 110p. Dep. NTIS, PC A06/MF A01.

Brookhaven National Laboratory established a new technology for load forecasting for the Long Island Lighting Company and prepared an independent forecast of the demand for electricity in the LILCO area. The method includes: demand for electricity placed in a total energy perspective so that substitutions between electricity and other fuels can be examined; assessment of the impact of conservation, new technology, gas curtailment, and other factors upon demand for electricity; and construction of the probability distribution of the demand for electricity. A detailed analysis of changing levels of demand for electricity, and other fuels, associated with these new developments is founded upon a disaggregated end-use characterization of energy utilization, including space heat, lighting, process energy, etc., coupled to basic driving forces for future demand, namely: population, housing mix, and economic growth in the region. The range of future events covers conservation, heat pumps, solar systems, storage resistance heaters, electric vehicles, extension of electrified rail, total energy systems, and gas curtailment. Based upon cost and other elements of the competition between technologies, BNL assessed the likelihood of these future developments. An optimistic view toward conservation leads to "low" demand for electricity, whereas rapid development of new technologies suggests "high" demand. (MCW)

6095 (CONF-771042—, pp 54-64) **Estimation of a model for electric utility demand in the presence of missing observations.** Robinson, P.M. (Harvard Univ., Cambridge, MA). Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

The estimation of models for demand of coal and oil by electric utilities is complicated by the presence of many zero observations, which seem to preclude the use of standard methods, such as regression. Also, the time-series characteristics of the data render inappropriate the estimates of "limited dependent variables" models, recently proposed by econometricians. Thus it is suggested that estimates of open-loop time-series models involve autoregressive structure in the dependent variable or the residual. The maximum-likelihood and related methods considered may prove computationally too onerous, so somewhat simpler types of estimate are proposed also. Applications to the data are described.

6096 (CONF-780231—) **Utility rate structuring. Official transcript of public briefing.** (Department of Energy, Washington, DC (USA). Office of Consumer Affairs). Jun 1978. 178p. Dep. NTIS, PC A09/MF A01.

From Utility rate structuring; Washington, DC, USA (28 Feb 1978).

Sam Hughes, Assistant Secretary for Intergovernmental and Institutional Relations, DOE, made the introductions at the public briefing on electric rate structuring, February 28, 1978 in Washington, D.C. Ms. Tina Hobson served as moderator. A panel of experts on energy issues responded to questions that consumer and public interest groups raised about energy issues, particularly electric rate structures. DOE panel members were: David Bordin, Charles Curtis, Robert R. Nordhaus, Hazel R. Rollins, and Douglas C. Bauer. Thirty-six questions previously submitted by consumer and public interest groups are listed and the answers prepared by DOE program offices are published in Appendix A. After the briefing, the questions posed at the meeting are re-examined and detailed answers are published by DOE program offices.

6097 (CONF-7706129—, pp 8p, Paper 3) **Electrical power management: energy and dollar savings through power factor improvement.** McKnight, V.B. (Caterpillar Tractor Co., Peoria, IL). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

Power-factor improvement is one of the practical and usable ideas for energy and dollar savings. Every year millions of dollars are wasted in America's industrial plants and commercial establishment because of lack of understanding of benefits to be derived from power-factor improvement. The waste is incurred in the form of unnecessary capital expense for electrical-distribution facilities and needless penalty charges on the electrical power bill. Power-factor improvement still offers a fertile field for cost reduction. Utility companies encourage power factor improvement through billing incentives because the utility company is faced with the same problem as the customer is. All of the utility's facilities—distribution, transmission, and generation—must be oversized to accommodate kVA. The author provides information for calculation of potential savings in energy and dollars.

6098 (CONF-7706129—, pp 7p, Paper 9) **Rate intervention: a means to keep utility costs down.** Smith, S.K. (Honeywell, Inc., St. Petersburg, FL). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

Intervening means becoming a third party to a proceeding begun by others to protect an interest. This may be as a third party in a public-service hearing concerning a utility proposal or as a witness before a legislative committee. The purpose is to keep utility rates at a level so the utility can provide adequate service and have the rates reflect cost to serve each class of customer. In industry, the plant engineer is the logical person to represent a company at a public-service hearing. He is knowledgeable about utility-rates, the uses of energy within the plant, the energy cost reductions that have been effected and are planned; and he can best project the effect of utility rate modifications. In some charts, data are presented on potential cost differences "cost to serve" versus "socialized" rates. Information on peak-load pricing, life-line rates, marginal or long-run incremental costs, and flattened or inverted rates is also charted. Some sample testimonies are published. (MCW)

6099 (CONF-7710136—, pp 97-107) **Regulatory effectiveness in the electric utility industry: an empirical analysis.** Zimmer, M.A. (Univ. of Evansville, IN). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

An established result in the theory of the regulated firm is that an effective rate-of-return constraint induces the firm to employ larger proportions of capital inputs to noncapital inputs than would

be the case in the absence of the regulatory constraint. This overcapitalization, often referred to as the Averch-Johnson effect, has been the subject of several recent empirical studies of the electric utility industry. This study seeks to test for the effectiveness of utility regulation in the context of a cost-minimization model which includes the allowed rate of return as an explanatory variable and permits arbitrary elasticities of substitution for any pair of inputs. 36 references.

6100 (TID—28799) **Program plan for development of underground hydroelectric pumped storage technology.** Lewis, L.G.; Sather, N.F. (Argonne National Lab., IL (USA)). Mar 1976. Contract W-31-109-ENG-38. 65p. Dep. NTIS, PC A04/MF A01.

The Underground Hydroelectric Pumped Storage (UHPS) Program Plan describes in detail the planned activities and expected accomplishments in the conduct of UHPS technology development and validation envisioned in the 1976 to 1990 time frame. This document describes the program objectives, implementation strategy, and management methodology. The concept of underground hydroelectric pumped storage is fully directed to application in the electric utility industry. This technology involves using electrical energy generated by base-load plants during off-peak load periods to drive a high-head pump/turbine which pumps water from a lower reservoir to a substantially elevated (upper) reservoir corresponding to a head of 1000 m or so. The upper reservoir is at ground level and the lower reservoir is below ground. Then, during peak-load periods, water in the upper reservoir is allowed to flow to the lower reservoir which, in turn, drives a hydraulic turbine for power generation. Intermediate reservoirs could be used for head-limited pumps. The underground concept is a variation of the conventional above-ground hydroelectric pumped storage, whereby the lower reservoir is at ground level and the upper reservoir consists of some suitable elevated catch basin as a nearby mountain lake. Many pumped storage plants with upper reservoirs located above ground level have been built and successfully operated in both Europe and the United States.

6101 **Electric energy R and D: planning for uncertainties.** Esselman, W.H. (Electric Power Research Inst., Palo Alto, CA). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 379-395(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Research activities being supported by the Electric Power Research Institute (EPRI) are reviewed. Discussions are included on EPRI's role in national research, electricity consumption, energy conservation effects, capacity expansion, availability of primary resources, financial issues, technical programs, government policies, fuel mixes, and conversion systems. (JRD)

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 5023, 5981

6102 (SAND—78-1639) **Impact of system energetics on the transition to inexhaustible energy resources for electric power generation.** Mitchiner, J.L. (Sandia Labs., Albuquerque, NM (USA)). Sep 1978. Contract EY-76-C-04-0789. 43p. Dep. NTIS, PC A03/MF A01.

The transition from conventional fuel-burning power-generation systems to nonfuel-burning systems that rely on inexhaustible energy resources is examined. This analysis determines the impact of system energetics (the balance of energy flows into and out of the energy-producing system) on the viability of making the transition. The system-energetics analysis is characterized by the fossil-fuel payback period, which is defined as the number of operating years required for the sum of the electrical energy produced and the fossil-fuel-equivalent energy inputs to equal zero. Energy models of both fuel-burning (nuclear reactor) and nonfuel-burning systems (solar thermal/electric) are developed. The optimal transition from an existing fuel-burning system to a nonfuel-burning system minimizes stored energy reserves (coal, uranium) required for completing the transition. The sensitivity of the transition-energy requirements is examined with respect to fossil-fuel payback period, plant lifetime, and energy-demand growth rates. A quantitative method is developed for comparing energy resource demands for systems with differing payback periods. These demands can then be compared with availability of known resources to assess the implications of the system energetics on the viability of making the transition. Based upon current estimates of solar-thermal-electric payback periods, energetics does not appear to be a constraint on large-scale deployment for power generation. A self-sustaining nonfuel-burning system will have thermal-capacity requirements at least 3 to 10 times larger than a comparable fuel-burning system. This implies greatly increased material demands; designs must use common materials and recycling must be implemented. It does not appear possible to maintain high energy-demand growth rates and simultaneously make a transition to the inexhaustibles for power generation.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 6020, 6049, 6059

6103 (CONF-7710136—, pp 7-15) **Energy conservation and U.S. farm-production patterns.** Pagoulatos, A. (Univ. of Kentucky, Lexington). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Energy-conservation practices in crop production would not substantially reduce energy use. Substantial reductions of energy would imply major structural changes in terms of extensive systems of crop production. The tradeoffs between land and energy for future desired crop outputs are derived.

6104 (CONF-7710136—, pp 133-142) **Increased aluminum use and its impact on the life-cycle energy cost of automobiles.** Omurtag, Y. (Univ. of Missouri, Rolla). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The life cycle of a passenger automobile including ore refining, manufacture of components, assembly, driving, and recycling is examined to provide a general computerized model to be used in evaluating the impact of various material-substitution rates and recycling policies on the total system energy consumption. The emphasis is on the use of increased aluminum to replace iron and steel. 4 figs., 20 refs.

6105 (COO—1340-57) **Modelling concept for energy utilization.** Reiter, E.R. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). 1977. Contract EY-76-S-02-1340. 18p. (CONF-771257—1). Dep. NTIS, PC A02/MF A01.

From American Geophysical Union meeting; San Francisco, CA, USA (5 Dec 1977).

Portions of document are illegible.

The present energy shortage will be with us for some time. In order to optimize the use of energy for space conditioning, computer models are required that relate the energy demand by individual buildings to design and occupancy specifications of that building, and to environmental weather sequences. The energy consumption by different types of buildings will have to be converted into community- and city-wide energy-use patterns. Such a model is presently available at Colorado State Univ. Refinement efforts are aimed at providing energy estimates for wide and diverse regions of the U.S., to judge what effects adverse weather conditions over prolonged time periods would have on energy requirements, and to estimate the adequacy or inadequacy of present power-transmission systems.

6106 (HCP/M3294—01) **Alternative fuels and intercity trucking.** Foster, R.W. (Miami Univ., Coral Gables, FL (USA); Escher Technology Associates, St. Johns, MI (USA)). Jun 1978. Contract EC-77-X-01-3294. 376p. Dep. NTIS, PC A17/MF A01.

This assessment of alternative fuels and the intercity trucking sector was jointly sponsored by two groups. Work related to near- and mid-term alternative fuels and general energy-conservation options was done under sponsorship of the U.S. Department of Energy as part of its Transportation Energy Conservation activities. Work on far-term alternative fuels was sponsored by the Ryder Program in Transportation of the University of Miami. The information presented is designed to accomplish three objectives: (1) provide energy- and alternative-fuels-technolog-oriented personnel with some basic understanding of the intercity trucking industry, its problems and achievements, and its accomplishments in energy conservation in general; (2) provide the intercity-trucking-industry-oriented reader with some basic understanding of the nature of alternative fuels, their production problems, and potential and possible mechanics of introduction into use; and (3) provide both groups with a rough overview of the status of alternative-fuels technology as applicable specifically to the high-speed diesel engine and tractor equipment presently in use. Recommendations are presented in the final section.

6107 (ORNL/CON—5) **Efficiency evaluation and consumer economic analysis of domestic water heaters.** Slaughter, G.G.; Spann, D.E. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 56p. Dep. NTIS, PC A04/MF A01.

The performances of one gas-fired and two electric storage-type water heaters were characterized experimentally as a function of water tank temperature. For both types of heaters the application

of additional insulation was highly cost effective. For the gas-fired water heater the pilot burner flue losses [92% at a water temperature of 150°F (65.6°C)] were reduced in a cost-effective manner by either pilot-orifice restriction or flue blocking with electric ignition. In addition, an electrically powered burner, with flue modifications, increased the heat-exchange efficiency of the main burner from 72 to 85% at 160°F (71.1°C). The heat-loss rate per unit of bare-tank area is a useful number in assessing the energy-conservation potential of a water heater.

6108 (ORNL/TM—6449) **Characteristics of automotive fleets in the United States, 1966—1977.** Shonka, D.B. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 47p. Dep. NTIS, PC A03/MF A01.

Several major areas pertaining to automobile fleet operations in the U.S. are covered. First, all known available sources that contain statistics on fleet vehicles are described. Second, fleet operations in the U.S. are characterized according to stock composition and operational characteristics. Third, properties of fleet cars are compared with those of the total car population, and a comparison is made among fleets used by different sectors. Finally, the significance of fleet operations for transportation energy conservation is discussed.

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 5441, 6069

6109 (CONF-771203—, pp 609-610) **Alternate energy as a curriculum base for teaching industrial arts on the secondary-post secondary level.** Greenwald, M.L. (Montclair State Coll., NJ). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6110 (CONF-771203—, pp 191-192) **Use of the space shuttle for energy resource development and monitoring.** Angelo, J.A. Jr. (Florida Inst. of Tech., Melbourne); Lange, J.J.; Lovill, J.E. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6111 (CONF-771203—, pp 585-587) **Energy sources for tomorrow: the possible role of non-nuclear and non-fossil energy resources.** Meliss, M. (Kernforschungsanlage, Juelich, Germany). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6112 (CONF-771203—, pp 779-783) **Assessment of energy conservation by using alternate energy sources in Kansas.** Pytlinski, J.T.; Eckhoff, N.D. (Kansas State Univ., Manhattan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

SOLAR

REFER ALSO TO CITATION(S) 5447, 5449, 5464, 5465, 5470, 5471, 5473, 5475, 5476, 5519, 5538, 5560, 5561, 5562, 5563, 5571, 5589, 5619, 6040, 6071, 6092

6113 (CONF-7710136—, pp 206-210) **National program for solar energy.** Davidson, K.; Gariboldi, R.J.; Purcell, J.J. (Dept. of Energy, Chicago). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

On October 26, 1974, the Solar Energy Research Development and Demonstration Act was signed into law authorizing a vigorous Federal program of research, development, and demonstration to establish solar energy as a viable energy resource. Solar heating and cooling of buildings represents a midterm help in an attempt to be less dependent on oil and natural gas. Many other solar programs underway in the development of solar energy are reviewed briefly.

GEOTHERMAL

REFER ALSO TO CITATION(S) 5672, 6071

OTHER

REFER ALSO TO CITATION(S) 5413, 5430, 5437, 5439, 5678

6114 (CONF-7706129—, pp 10p, Paper 2) **Solid waste produces new energy sources for industry.** Howard, A.H. (Wheelabrator Energy Systems Co., Hampton, NH). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

The increasing problem of solid-waste disposal and the cost and availability of fossil fuels focuses new interest on incineration of waste with heat recovery. This paper reviews the joint planning that must be done between industry and local and state governments in order to complete a project beneficial to all concerned. The paper discusses the integration of steam from an incineration plant with that derived from fossil systems and the design requirements to assure continuity of supply to an industrial plant. Specifically, the paper presents a "case history" review of developments leading to the purchase of steam by a large industrial plant from a solid-waste incineration plant disposing of 1200 ton/day of municipal solid waste. In addition, the design features of the plant are discussed, emphasizing the pollution-control aspects of the plant required to satisfy national and local regulations.

ENERGY CONVERSION

MHD GENERATORS

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 4977

6115 (FE—1542-4) **Final report on the design of the MHD generator channel for the high performance demonstration experiment.** Schmidt, H.J. (ed.). (MEPPSCO, Inc., Boston, MA (USA); ARO, Inc., Arnold Air Force Station, TN (USA)). Aug 1977. Contract EX-76-A-01-1542. 108p. Dep. NTIS, PC A06/MF A01.

The MHD generator for the MHD Performance Demonstration Experiment is designed to demonstrate that enthalpy extraction of the order of 16 to 18% at a turbine efficiency greater than 60% is achievable for commercial application. The generator channel is designed to operate with a subsonic flow of seeded combustion products in a 6 Tesla (T) magnetic field and deliver up to 50 MW of electrical power with a 60 kg/sec mass flow. The heat sink design of the channel limits the operating duration to 15 sec which is adequate to demonstrate performance. Physically, the generator channel is 9 m long, 0.82 m wide by 0.60 m high at the inlet and 1.32 m wide by 1.08 m high at the exit. The channel is fabricated in five sections for ease in handling. The channel consists of an outer pressure vessel lined with a copper heat sink in the form of interior electrode and insulating walls. The outer pressure vessel is comprised of NEMA G-11 laminated fiberglass panels circumferentially reinforced with external stainless steel frames. The interior insulating wall is comprised of 1.9 cm square copper pegs end mounted to the wall with a 1.6 mm refractory filled insulating gap between adjacent pegs. The copper electrodes span the channel height on either side and are similarly insulated from each other. Graphite caps on the electrodes are utilized to produce a high surface temperature and resulting favorable electrical contact with the plasma. There are 485 pairs of electrically accessible electrodes of which only 418 pairs spanning 7 m length in the middle of the channel will be connected to individual loads in the Faraday configuration. The channel is designed to also be operated in an externally connected diagonal configuration in which a single load is connected between inlet and exit electrodes and selected anode and cathode electrodes are shorted elsewhere.

6116 (FE—2215-9) **Critical contributions in MHD power generation. Quarterly technical progress report, June 1—August 31, 1977.** Louis, J.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Oct 1977. Contract EX-76-C-01-2215. 254p. Dep. NTIS, PC A12/MF A01.

Current research and development in open-cycle coal-fired MHD power generation at Massachusetts Institute of Technology is presented. Progress is reported on the following tasks: (1) Establish chemical, thermal, and electrical data to guide materials selection,

develop improved detail designs, and support performance analyses of MHD electrode modules and insulator materials; (2) Parametrically investigate selected electrode properties of critical design importance in chemical, thermal, and electrical environments simulating a coal-fired MHD generator; (3) Develop combustion data pertinent to the design of MHD combustors; this work is intended to determine the combustion characteristics of selected coal feed stock in terms of devolatilization kinetics, char characteristics, and combustion gas chemistry; (4) Establish techniques for the analysis and understanding of critical MHD phenomena which have an important bearing on MHD generator performance; such phenomena include inter-electrode breakdown, time-dependent behavior, effective plasma properties and plasma inhomogeneities; (5) Establish the operating characteristics of an MHD disk generator; (6) Continue work on computer techniques for modeling and for design and cost analysis of MHD components and the overall system; (7) Integrate the engineering data and design criteria, as applicable, which are developed in the above-listed tasks into a model of the MHD channel.

6117 (FE—2215-10) **Critical contributions in MHD power generation. Quarterly technical progress report, September 1—November 30, 1977.** Louis, J.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Dec 1977. Contract EX-76-C-01-2215. 188p. Dep. NTIS, PC A09/MF A01.

Research and development in open-cycle coal-fired MHD power generation at Massachusetts Institute of Technology (MIT) is summarized. Progress is reported on the following tasks: (1) Establish chemical, thermal, and electrical data to guide materials selection, develop improved detail designs, and support performance analyses of MHD electrode modules and insulator materials; (2) parametrically investigate selected electrode properties of critical design importance in chemical, thermal, and electrical environments simulating a coal-fired MHD generator; (3) develop combustion data pertinent to the design of MHD combustors; this work is intended to determine the combustion characteristics of selected coal feedstock in terms of devolatilization kinetics, char characteristics, and combustion gas chemistry; (4) establish techniques for the analysis and understanding of critical MHD phenomena which have an important bearing on MHD generator performance; such phenomena include inter-electrode breakdown, time-dependent behavior, effective plasma properties and plasma inhomogeneities; (5) establish the operating characteristics of an MHD disk generator; (6) continue work on computer techniques for modeling and for design and cost analysis of MHD components and the overall system; (7) integrate the engineering data and design criteria, as applicable, which are developed in the above-listed tasks into a model of the MHD channel; (8) participate in technical support of the DOE MHD Project Office.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 6122

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 6116, 6117

6118 (FE—2248-16) **Final report on the joint U.S.—U.S.S.R. test of the U.S. MHD electrode system in the U-02 Facility. Phase II (September 21—September 27, 1976).** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Labs.). Dec 1977. Contract EX-76-C-01-2248. 331p. Dep. NTIS, PC A15/MF A01.

The second (Phase II) joint U.S.-U.S.S.R. test of U.S. electrode materials was carried out in Moscow between September 21 and September 27, 1976 in the Soviet U-02 MHD Facility. The test procedure followed closely a predetermined work plan designed to test five different electrode materials, different leadouts and attachments, and the cathode and anode electrode walls under MHD operating conditions. The materials which were selected were Graded CeO_2/ZrO_2; 50 CeO_2-50 ZrO_2; 75 $MgAl_2O_4$-25 Fe_3O_4; 75 $FeAl_2O_4$-25 Fe_3O_4; and 95 $LaCrO_3$-5 Mg. The materials were arranged into modules of five electrodes apiece each with its own heat sink. Opposing electrodes on the anode and cathode were of the same material. The cathode and anode wall had six modules apiece. The opposing electrodes were separately loaded to various assigned current densities during the experiment which lasted a total of 131 hours with 75 hours under MHD power operational conditions. There were four main phases in the test schedule: (1) Start-up of the channel over a specific heating period. No K_2CO_3 seed introduction. (2) Electrophysical tests of the electrodes at operating temperature with seed and magnetic field. (3) Operating life test of electrodes at various assigned current densities. (4) Shut-down of the channel over a specific cool down period. Extensive pre- and post-test materials characterizations were made to determine the effect of the MHD environment on the electrodes and insulators. Pre-test measurements were made to determine: thermal diffusivity, thermal expansion, chemical composition, microstructure, electrical conductivity, phase composition, closed and open porosity and pore size distribution.

6119 (FE—6010-T1) **Development, testing and evaluation of MHD-materials. Quarterly report, January—March 1978.** Hosler, W.R.; Negas, T.; Schneider, S.J. (National Bureau of Standards, Washington, DC (USA). Center for Materials Science). 31 Mar 1978. Contract EA-77-A-01-6010-035. 91p. Dep. NTIS, PC A05/MF A01.

A synthetic coal slag was made and viscosity determined in ambient atmosphere for comparison with its viscosity under high pressure steam to evaluate the role of water. The electrical conductivities of numerous promising electrode materials have been measured. The potassium pressure dependence on bulk K_2O composition of Eastern and Western coal slags is significantly less than that for two glassy slags measured previously. Iron interdiffusion coefficients were determined from diffusion measurements on couples composed of materials x-y-x where x is MAFF 31 (magnesium aluminate ferrous ferrite), and y is either $MgAl_2O_4$ (S 71) or MgO. A method for determining the partial electronic conductivity of coal slag at high temperatures is described. Electrochemical experiments were started under simulated slag flow conditions to evaluate candidate electrode materials and to determine if slag flow prevents degenerative polarization and attack. Approximately 60 materials have been analyzed structurally by x-ray diffraction methods. Pre- and post-test characterization of materials from several tests is given. These include, (1) a detailed report on the AVCO Test of General Electric Co. Electrodes 9/27/77; (2) a report on the USSR-UTSI test samples composed of SiC + Ti, and (3) a synopsis of the completed final report on the second proof test for U-O2 Phase III, the US-USSR cooperative program on MHD materials. Several new materials have been analyzed. Exploratory data related to $YFeO_3$-type materials have been obtained with the main emphasis on $YFeO^3$$_3$-CaFeO/sub 2.5/-$CaZrO_3$ solid solution and composites. Samples of Mg doped $LaCrO_3$ where the Mg content is less (2%) than the usual 5% amount have been examined by SEM, EDX and X-ray powder diffraction techniques.

6120 (PNL-SA—6851) **Evaluation of Phase III U-02 proof test materials.** Rossing, B.R.; Cadoff, L.H.; Kuszyk, J.A.; Marchant, D.; Bates, J.L.; Negas, T.; Cook, L.P.; Farabaugh, E.N.; Hosler, W.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA); Battelle Pacific Northwest Labs., Richland, WA (USA); National Bureau of Standards, Washington, DC (USA)). Mar 1977. Contract EY-76-C-06-1830. 7p. (CONF-780307—10). Dep. NTIS, PC A02/MF A01.

From 17. symposium on engineering aspects of MHD; Stanford, CA, USA (27 Mar 1978).

Ten electrode and four insulator materials were evaluated as candidate materials for the third US/USSR joint test of electrode walls in the U-02 facility in Moscow. This evaluation was made on the basis of three proof tests conducted in the Westinghouse Electrode Systems Test Facility and the subsequent post-test material analysis. Three hot pressed electrodes based upon $LaCrO_3$ and sintered insulators of HgO and $MgAl_2O_4$ were judged to be most resistive to the anticipated U-02 MHD environment. The predominant mode of degradation was seed corrosion of cathodes. Seed attack could be correlated with the presence of secondary phases, porosity and cracks.

6121 (TID—28268) **Development, testing and evaluation of MHD-meterials. Quarterly report, October—December 1977.** Frederikse, H.P.R.; Negas, T.; Schneider, S.J. (National Bureau of Standards, Washington, DC (USA). Inst. for Materials Research). 31 Dec 1977. Contract EA-77-A-01-6010-035. 96p. Dep. NTIS, PC A05/MF A01.

Work continued on preparation for the U-O2 Phase III materials test to be held in Moscow early in 1978. Pretest electrical conductivities and x-ray diffraction data on all candidate materials have been completed. The post test characterization of the materials tested in the first proof test for U-O2 Phase III has been completed. A comprehensive program has started to determine the chemical and electrochemical reactions involved at the boundaries between molten (and solid) slag and various electrode materials at different temperatures. Electrodes of design based partly on the results of these experiments are being constructed for future tests at AVCO. Further progress has been made on the seed-slag interaction problem including especially the relation between melt composition and temperature in partially crystallized slags. The effect on viscosity caused by changes in concentration of each oxide of a five component slag at 1600 and 1300°C are shown. Viscosity vs. temperature relationships are shown for slags from fly ash of a power plant at Bow, New Hampshire and slag from coal from the Montana Rosebud seam. Vapor pressure measurements of K over a K_2O—SiO_2—Al_2O_3 glass having an SiO_2/Al_2O_3 weight ratio of 5 indicate an enhanced K_2O activity down to 20 w/o K_2O; measurements over a glass having an SiO_2/Al_2O_3 ratio of 2 show reduced activity as compared to K_2O—SiO_2 solution. Diffusion of iron from iron containing electrode materials appears to be less in the insulator magnesium aluminate than in pure MgO under identical laboratory condi-

tions. Some 60 materials were analyzed by XRD. These materials included those submitted by industrial firms and other governmental laboratories as well as materials under study in the NBS materials program.

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 6115, 6117

6122 (ANL/MHD—78-2) **Experimental two-phase liquid-metal magnetohydrodynamic generator program. Annual report, October 1976—September 1977.** Petrick, M.; Fabris, G.; Pierson, E.S.; Fischer, A.K.; Johnson, C.E. (Office of Naval Research, Arlington, VA (USA)). May 1978. Contract W-31-109-ENG-38. 104p. Dep. NTIS, PC A06/MF A01.

Testing of the second diverging-channel generator with the revised ambient-temperature NaK-N_2 facility has been completed. The primary goal of the revised facility, demonstrating reduced slip ratio (ratio of gas velocity to liquid velocity) with higher liquid velocity (flow rate), was accomplished. The reduction in slip ratio was dramatically demonstrated by a series of consecutive runs with varying flow rate (from 6 kg/s to 12 kg/s for the liquid). Substantial increases in generator efficiency were obtained with higher liquid flow rates. Experiments to demonstrate that good liquid-to-gas heat transfer exists in the generator were successfully completed. Good heat transfer is essential because it is the almost-constant-temperature expansion of the gas (vapor) in the generator that yields the higher system efficiencies for liquid-metal MHD power cycles. The feasibility of generating relatively-stable bubbles, hence, a foam, in liquid metals has been demonstrated. Photographic documentation of these phenomena, both motion and still pictures, was made. Surface tension measurements and foaming experiments have shown that viscosity is also a factor in promoting bubble formation and persistence. Wetting and contact angle measurements have been made for stainless steel and carbon steel immersed in eutectic NaK. An analytical study of the liquid shunt (wall) layer sizes and losses has shown that these losses are not expected to be significant for large generators; less than 1.0 percent decrease in efficiency is anticipated. A two-phase pressure-gradient correlation developed for MHD flows has been shown to agree to within 20 percent with the generator data.

6123 (CONF-780307—12) **Experimental and analytical investigation of fluctuating phenomena within a subsonic combustion MHD generator.** Barton, J.P.; Koester, J.K.; Mitchner, M. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). 1978. Contract EX-76-C-01-2341. 9p. Dep. NTIS, PC A02/MF A01.

From 17. symposium on engineering aspects of MHD; Stanford, CA, USA (27 Mar 1978).

The results of the measurement of inherent pressure and transverse electric field fluctuations within a subsonic, combustion-driven Faraday generator are presented as a function of generator operating conditions. Statistical analyses as the spectral density function, the cross correlation coefficient, and the coherency function are used to analyze the character of these measurements. A correlation between pressure fluctuations and electric field fluctuations is shown. A theoretical model based on the observed experimental results describes fluctuating phenomena within the generator in the terms of the amplitudes of three traveling waves. A first comparison between theoretical predictions and experimental results is given.

6124 (CONF-780307—13) **Preliminary experiments concerning inhomogeneities in combustion MHD generators.** Kowalik, R.M.; Kruger, C.H. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). 1978. Contract EX-76-C-01-2341. 11p. Dep. NTIS, PC A02/MF A01.

From 17. symposium on engineering aspects of MHD; Stanford, CA, USA (27 Mar 1978).

It is known that electrical conductivity inhomogeneities may cause a reduction in the effective conductivity and power output of an MHD generator, especially at high magnetic fields. Recent theories have suggested that the structure and geometry of the inhomogeneities are important factors in the determination of the extent of these effects; however, little or no experimental data is available to characterize the structure of inhomogeneities in combustion MHD plasmas. Some preliminary inhomogeneity experiments conducted in the Standard M-2 facility and a promising laser fluorescence diagnostic which is being developed for future inhomogeneity experiments are described.

THERMIONIC CONVERTERS

DESIGN AND DEVELOPMENT

6125 (COO—3056-33) **NASA/DOE Advanced Thermionic Technology Program. Progress report No. 31, January 1978.** (Thermo Electron Corp., Waltham, MA (USA)). 1978. Contract EY-76-C-02-3056. 19p. (TE—4233/4237-110-78). Dep. NTIS, PC A02/MF A01.

The status of plasma studies is discussed including converter theory, experimental plasma analysis, and enhanced mode conversion experiments. Optimized performance data for convertor No. 186 with an Inconel 671 emitter and nickel collector are presented. Status of hot shell development and the miniature flame-heated device is described. Also, results of a design study for thermionic topping of fossil fueled power plants are summarized. (WHK)

6126 (TE—4233/4237-120-78) **DOE/JPL advanced thermionic technology program. Progress report No. 32, February—March 1978.** (Thermo Electron Corp., Waltham, MA (USA)). 1978. Contract EY-76-C-02-3056. 24p. Dep. NTIS, PC A02/MF A01.

Optimized performance data for converter No. 183 with a L605 alloy emitter and a nickel collector are presented for emitter temperatures of 1300, 1400, and 1500 K. The L605 work function is plotted versus the ratio of emitter temperature to cesium reservoir temperature. Progress on the combustion-heated thermionic device and hot shell development are reported. The design of the guarded triode converter with a ring electrode is described. A diagram of the variable-spaced hybrid converter is included. (WHK)

6127 (TID—28556) **Advanced thermionic energy conversion. Joint highlights and status report, January—February 1978.** (Rasor Associates, Inc., Sunnyvale, CA (USA)). 1978. Contract EY-76-C-02-2263. 17p. Dep. NTIS, PC A02/MF A01.

The status of negative ion converter tests for improving converter performance by reducing the hydrogen negative ion impurities is outlined. Construction of various thermionic converter test models is discussed. An analytical model of a converter with an argon plasmatron ion source is described. (WHK)

6128 (TID—28568) **Advanced thermionic energy conversion. Joint highlights and status report, November—December 1977.** (Rasor Associates, Inc., Sunnyvale, CA (USA)). 1977. Contract EY-76-C-02-2263. 5p. Dep. NTIS, PC A02/MF A01.

Studies of negative ion effects in thermionic converters are outlined. It was found that adverse negative ion effects were caused primarily by hydrogen impurities. Plans for an experiment with better cesium distillation and gas gettering schemes are discussed. (WHK)

FUEL CELLS

6129 (CONF-771203—, pp 187-189) **Environmental assessment of residential energy supply systems that use fuel cells.** Steele, R.V. (SRI International, Menlo Park, CA); Johnson, G.L.; Ciprios, G. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

DESIGN AND DEVELOPMENT

6130 (CONF-771203—, pp 183-185) **Feasibility study of a regenerative solid polymer electrolyte fuel cell system using hydrogen/chlorine reactants for high efficiency energy storage.** Nuttall, L.J.; McElroy, J.F.; Srinivasan, S.; Hart, T.G. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6131 (CONF-780808—20) **Analysis of performance capabilities of redox-flow storage batteries.** Roy, A.S.; Kaplan, S.I. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From Meeting of the American Section of the International Solar Energy Society; Denver, CO, USA (28 Aug 1978).

Major physical performance parameters and economic factors of a generalized redox-flow storage battery system are analyzed. The system is divided into power-related and energy-related subsystems. The economic factors include plant capital (and other) costs, electrical energy lost by the storage-cycle inefficiency, and a penalty term for failures. Relationships are formulated for the overall system efficiency and system performance parameters (voltages, current density, state-of-charge of the storage liquid, and parasitic losses). Equations for sizing and costing of the battery and the storage tank subsystems are given. Directions for needed research are indicated.

MATERIALS, COMPONENTS, AND AUXILIARIES

6132 (CONF-7805100—1) **Electrocatalyst-support interactions.** Kinoshita, K. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 23p. Dep. NTIS, PC A02/MF A01.

From Workshop on the electrocatalysis of fuel cell reactions; Upton, NY, USA (15 May 1978).

The maximum utilization of noble metals as heterogeneous catalysts is achieved by dispersing the noble metals as small particles supported on a porous, high surface area powder. In some studies with supported noble metal catalysts, it has been reported that the metal particle interacts with the support material and that the interaction affects the catalytic properties of the metal. Experimental studies on metal-support interactions that are pertinent to electrocatalysis will be discussed. Platinum supported on carbon black is one of the most active electrocatalysts for oxygen reduction in phosphoric acid fuel cells. In the acid environment at 100 to 200°C, the Pt surface area decreases with time due to the growth of the supported Pt particles. The effects of a liquid-phase environment on the particle growth mechanism of supported Pt catalysts is discussed. 60 references.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 5451, 5997, 6006, 6018, 6047, 6061, 6094

6133 (CONF-771203—, pp 205) **Energy policy optimization by environmental systems analysis.** Stover, L.V. (NUS Corp., Rockville, MD). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6134 (CONF-771203—, pp 377-378) **Impact of oil price increases on the competitiveness of non-conventional energy technologies.** Farrelly, P.J. (Exxon Enterprises Inc., New York). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6135 (CONF-771203—, pp 377-378) **Energy policy in Venezuela.** Martinez, A.R. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6136 (CONF-771203—, pp 379-380) **Towards a rational energy supply system: economics and diseconomics of scale in an expensive energy future.** Kah, G.F.; Steingass, H.D. (Donovan, Hamester, and Rattien, Inc., Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6137 (CONF-771203—, pp 381-382) **Alternative energy sources and conservation technologies: optimal systems.** Kah, G.F. (Donovan, Hamester, and Rattien, Inc., Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6138 (CONF-771203—, pp 383-385) **Energy use and society in the 21st century.** Appleby, A.J. (CNRS, Bellevue, France). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6139 (CONF-771203—, pp 387-389) **Unified methodology for cost analysis of energy technologies.** Phung, D.L. (Oak Ridge Associated Universities, TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6140 (CONF-771203—, pp 391-393) **Strategies for alternative energy systems.** Ferrell, G.C. (International Inst. for Applied System Analysis, Laxenburg, Austria). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6141 (CONF-771203—, pp 395-397) **Survey and appraisal of primary future energy sources.** Root, D.H. (Geological Survey, Reston, VA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6142 (CONF-771203—, pp 595-596) **Transmission of energy by open-loop chemical energy pipeline.** Baker, N.R.; Scott, M.I.; Tison, R.R.; Whaley, T.P. (Inst. of Gas Tech., Chicago). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6143 (CONF-771203—, pp 731-735) **Conservation as an energy source.** Belding, J.A. (Energy Research and Development Administration, Washington, DC). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6144 (CONF-771203—, pp 757-759) **Renewable energy supplies for developing countries.** Twidell, J.W. (Univ. of Strathclyde, Glasgow). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6145 (CONF-771203—, pp 769-770) **Energy, helium, and the future.** Krupka, M.C.; Hammel, E.F. (Los Alamos Scientific Lab., NM). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6146 (CONF-771203—, pp 775-777) **Energy impact on economic activity and long-range trend forecast.** Hokkyo, N. (Hitachi Atomic Energy Research Lab., Kawasaki, Japan). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

BUILDINGS

REFER ALSO TO CITATION(S) 5439, 5714, 6044, 6048, 6059, 6077, 6105, 6182, 6206

6147 (ANL/EES-TM—12) **Pulse combustion technology for heating applications. Quarterly progress report, April—June 1978.** Ahrens, F.W. (Argonne National Lab., IL (USA)). Jul 1978. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

This is the first Quarterly Progress Report on the pulse combustion research program. As such, it presents background information and objectives for three major program phases: burner performance relationships; noise sources and noise reduction; and technology evaluation and application. Recent progress in these areas is summarized. The most significant items discussed pertain to the design of a versatile experimental burner at ANL and to the experimental program on burner noise and performance in progress at Purdue University.

6148 (ANL/ICES-TM—10) **Feasibility of a district cooling system using natural cold water.** Jitco, T. (Tracor JITCO, Austin, TX (USA)). Dec 1977. Contract W-31-109-ENG-38. 39p. Dep. NTIS, PC A03/MF A01.

The findings of investigations into the use of natural cold water district cooling systems are outlined. Concepts involving the use of natural cold water for cooling commercial and residential buildings have been examined and found to be economically sound and technically feasible. Studies indicate that naturally occurring cold water sources exist in proximity to certain municipal areas that have large cooling demands. Savings in energy resources, long term cost benefits, and environmental safety are the most attractive features of natural cold water cooling.

6149 **Considerations on the use of gas-driven high-power heat pumps in district-heating supply areas.** Proske, M. (Stadtwerke Bielefeld G.m.b.H. (Germany, F.R.). Hauptabteilung Technische Planung). *Fernwaerme Int.;* 7: No. 2, 29-32(May 1978). (In German).

In order to save investment for district-heating transmission lines it is possible, at heavily loaded points in district-heating systems supplied from heat-electric stations, to make use of gas heat pumps. The heat sources used may be the return feed from district-heating, and other media. The energy from the different heat sources must be evaluated from the cost point of view. The article describes a simple method by which the overall energy expenditure can be determined, and also an estimate of the efficiency of such gas heat-pump systems.

6150 (CONF-771203—, pp 597) **Significance of ambient energy tectonics.** Bowen, A. (Univ. of Miami, Coral Gables, FL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6151 (CONF-771203—, pp 729-730) **Seasonal heat pump performance for a typical northern United States environment.** Briggs, J.B.; Shaffer, C.J. (EG and G Idaho, Inc., Idaho Falls). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6152 (CONF-780801—35) **Large-scale cogeneration/district heating studies for the Minneapolis—St. Paul area.** Karnitz, M.A.; Rubin, A.M. (Oak Ridge National Lab., TN (USA); Department of Energy, Washington, DC (USA)). 1978. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The Department of Energy, Minnesota Energy Agency, Northern States Power Company, and other local government and private organizations are cooperatively performing an in-depth application study to determine the feasibility of district heating for a large northern U.S. city. Over 90% of the space and water heating requirements in the United States are currently supplied by oil and gas. Hence, district heating can potentially replace large quantities of scarce or imported fuels with coal or nuclear resources. In addition, district heating, using a cogeneration power plant, substantially increases the fuel utilization efficiency when compared to an electric only plant. A Swedish firm, AB Atomenergi, is performing a preliminary economic and technical assessment. The analysis uses current Swedish district heating technology and experience, and adapts it, where necessary, to U.S. conditions. Preliminary Swedish results indicate favorable economics for a large system, which includes residential areas, when technology innovations such as temperature resistant plastic piping are used. For conventional piping technology the economics appear favorable for the commercial areas of the city core.

6153 (LBL—7828) **Energy efficiency and performance of solid state ballasts.** Verderber, R.; Selkowitz, S.; Berman, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 16p. (CONF-780808—19). Dep. NTIS, PC A02/MF A01.

From Meeting of the American Section of the International Solar Energy Society; Denver, CO, USA (28 Aug 1978).

The performance of solid state ballasts for operating fluorescent lamps measured in a controlled laboratory environment are described and compared to the performance of typical core-coil type ballasts. Parameters of interest include efficiency, conducted and radiated EMI and results of some accelerated lamp life tests. The experimental design of the demonstration to retrofit three floors of an office building with solid state ballasts to evaluate their reliability and energy savings in a variety of applications is described. The most recent experimental results are presented.

6154 **Energy saving means reducing power used by lamps.** Chambliss, H.D. US Patent 4,097,782. 27 Jun 1978. Filed date 15 Dec 1975. 6p.

Energy is saved in lighting lamps by pulse operation at periodic duty cycles of less than 100% on time with little effect on apparent brightness when viewed by the normal human eye because of the quality of retention of a peak flask for a finite time. At periodic frequencies above about fourteen cycles the lamps appear to be continuously energized with little flicker.

6155 **Heat pump device.** Madsen, H.B. (to Svenska Geotherm Aktiebolag). US Patent 4,091,994. 30 May 1978. Priority date 10 Mar 1975, Denmark. 4p.

A heat pump for the simultaneous heating of hot water for consumption and water for heating radiators is described that is comprised of the heat pump itself and a water reservoir heated by the condenser of the heat pump. The water reservoir is enclosed by a fluid holding cover which forms a part of the heating radiator system. Means are provided for regulating the part of the water of the heating system that passes through the cover and the part of the water that passes through a by-pass branch around the cover. The relation between the two parts may be thermostatically regulated.

6156 **Heat pump system.** Margen, P.H.E. (to Aktiebolaget Atomenergi). US Patent 4,091,636. 30 May 1978. Priority date 3 Feb 1976, Sweden. 6p.

A heat pump system is described that has a vaporizer in heat exchange relationship with a glycol/water circuit which comprises an earth heat absorber and an ambient air heat absorber in parallel.

6157 **Apparatus for attaching roof insulating sheets and similar objects.** Kjoelsrud, B. US Patent 4,091,850. 30 May 1978. Priority date 23 Jul 1975, Sweden. 4p.

The invention discloses an apparatus designed to attach sheets preferably insulating sheets of, e.g., mineral wool, to an underlying layer, such as profiled sheet metal, by using centrally apertured washers and screws that are driven through the washer and the insulating sheet and into the underlying layer, thus securing the insulating sheet thereto. The apparatus which is run across the insulating sheet comprises means for feeding the washers, one at a time, to the desired points of attachment on the sheet, means for time and place controlled feeding of screws to the washers already deposited in place, and a drill means arranged to engage said screws so as to drive them down, through the insulating sheet and into the underlying layer.

6158 **Fuel efficiency booklet. 12. Energy management and good lighting practices.** London; Department of Energy ([nd]). 12p.

Guidance is provided to energy managers on good lighting practice and the effective use of energy. Opportunities for reducing energy requirements, and at the same time maintaining or improving lighting standards are discussed. It is suggested that expert advice be sought either from the electrical supply industry, the manufacturers of lighting equipment, or consultants before any scheme of replacement or improvement of lighting is embarked upon.

6159 **Fuel efficiency booklet. 8. The economic thickness of insulation for hot pipes.** London; Department of Energy ([nd]). 40p.

The insulation of steam and hot water pipes for space heating and process applications is discussed. Preventable heat losses, insulation thicknesses, and economic thicknesses of insulation are discussed. Directions for calculation methods, monograms, and some tablulated data are included for determining economic thicknesses. Additional data are included on materials and applications.

6160 **Fuel efficiency booklet. 10. Controls and energy savings.** London; Department of Energy ([nd]). 12p.

The need for making the best use of heating and air conditioning equipment controls to ensure that they are adequately maintained and inspected at regular intervals is discussed. In every building and industrial process energy is used and wasted in some form or other. Whether in a house, factory, hospital, or office, energy is being consumed to produce heat, light, or power. This energy costs money, i.e., an increasing amount of money, day by day, week by week. The aim of this booklet is not only to help reduce the cost of the energy we use, but equally important, to cut down the amount of energy waste. To do this controls are needed to ensure that just the right amount of energy, and no more, is used.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 5563, 5591, 6040, 6060, 6065, 6107

6161 (CONF-771042—, pp 65-68) **Heat balance in housing: theory and results of a retrofit experiment.** Woteki, T.H. (Princeton Univ., NJ). Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

An experiment was designed to assess the effects of retrofits on the heat balance in a sample of occupied houses. In particular, the theoretically expected vs. empirically determined effects on heat loss of installing additional insulation in attics were examined, as were the implications for policy analysis. The statistical analyses featured use of robust methods applied to large sets of primary data collected in the field.

6162 (CONF-771203—, pp 749-752) **Extraction of sensible heat from waste water for domestic heating application.** Varde, K.S. (Univ. of Michigan, Dearborn). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6163 (CONF-780801—37) **Contributions of improved technologies to reduced residential energy growth.** Hirst, E.; O'Neal, D. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The paper evaluates the energy conservation potential of improved technologies for delivering residential energy services such as space heating and water heating. Both improvements to present-day technologies (e.g., additional insulation in attics, use of electric ignition in gas equipment) and development of advanced technologies (e.g., gas-fired heat pumps, LITEK lamp) are considered.

6164 (CONF-780843—1) **ORNL engineering-economic model of residential energy use: structure and results.** Hirst, E.; Carney, J. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02/MF A01.

From Conference on net energy analysis and energy modeling; Colorado Springs, CO, USA (21 Aug 1978).

The ORNL residential energy use model was developed to simulate energy use in the residential sector from 1970 through 2000. The model provides considerable detail on annual energy uses by fuel, end use, and housing type; and also estimates annual equipment installations and ownership, equipment energy requirements, structure thermal performance, fuel expenditures, equipment costs, and costs for improving thermal performance of new and existing housing units. Thus, the model provides considerable detail on residential energy uses and associated costs. These details are useful for evaluating alternative energy conservation policies, programs, and technologies for their energy and economic effects during the next quarter century.

6165 **Fireplace heat extractor.** Stites, J.J. US Patent 4,091,794. 30 May 1978. Filed date 24 Nov 1976. 6p.

The invention discloses a fireplace heat extractor comprising an air-shield, such as a glass screen, to be mounted across the fireplace opening with manually controlled, limited capacity openings therethrough that admit just enough air into the fireplace to support combustion. Baffle means prevent such air from bypassing the fire. A blower directs air through a horizontal header extending through the air-shield into place, and then through an array of tubular air ducts which extend downwardly and rearwardly from the header to function also as a fire basket. The ducts extend up along the back of the fireplace and then forwardly to open back through the air-shield into the room. Replaceable fill bars are positioned between the fire basket portion of the ducts to improve coal-supporting characteristics.

6166 **House trap.** Meeks, C.; Ouderkerk, E. (Dept. of Consumer Economics and Housing, Washington, DC). *Hum. Ecol. Forum;* **8**: No. 3, 8-11(Win 1978).

The preferred mode of living in the U.S. is the single-family home. With energy no longer cheap and abundant, many are discovering themselves hostage to a dwelling they find difficult to afford. Housing's share of the family budget rose from 27% in 1950 to 31% in 1973. Rapid increases in the price of fuel oil No. 2, natural gas, and electricity have put the most critical pressure on the family budget. Rate reform proposals, such as lifeline rates which would guarantee a set amount of energy to households at a set rate, and off-peak pricing which would set rates at a lower rate for consumption in low-use hours, do not guarantee lower bills. As power plants convert to coal to generate electricity, the expense will be passed on the the consumer. The only available escape for households is to alter energy consumption patterns. Low-income households often lack the ability to control their consumption. Better off households can afford energy saving equipment but may value a house that consumes a lot of energy. Government policy dealing comprehensively with housing and energy should be formulated.

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 6043, 6054, 6153

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 6050, 6051

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 6019, 6043, 6052, 6053, 6055, 6056, 6057, 6058, 6065

TRANSPORTATION

REFER ALSO TO CITATION(S) 6077

RAILWAY

REFER ALSO TO CITATION(S) 6012

6167 **Managerial decision-making criteria in urban mass transit.** Horn, K.H. (Interstate Commerce Commission, Washington, DC). *Transport. J.;* **17**: No. 4, 56-72(Sum 1978).

The rapid growth of the public sector in urban transportation in North America to a predominant role in terms of assets, employees, and output has had profound effects on the management of urban transit systems. While the manner and method of public ownership varies widely—ranging from the operation of transit within a municipal department or agency to an independent corporation with an elected or appointed board of directors—the shift in emphasis of transit from a private for-profit orientation to a public service has wide and diverse implications for transit officials and public policymakers concerned with urban mobility. Results are presented from a survey of 8 Canadian and 28 U.S. transit agencies and operators, which requested that the respondent indicate the availability and frequency of collection of data hypothesized to be relevant to measuring transit performance.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 6046, 6049, 6062, 6104, 6106, 6108, 6180

PIPELINE

REFER ALSO TO CITATION(S) 6045

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 5996, 6038, 6063, 6064

6168 (CONF-771203—, pp 739) **Energy utilization in industry: the case of Israel.** Sonnino, T. (Israel Atomic Energy Commission, Tel-Aviv). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6169 (ORAU/IEA—78-14(M)) **Energy use in the production of primary aluminum.** Boercker, S.W. (Oak Ridge Associated Universities, Inc., TN (USA)). Aug 1978. Contract EY-76-C-05-0033. 51p. Dep. NTIS, PC A04/MF A01.

As a part of a study of the possibilities of using alternate energy systems in industry, a review of the processes used in the production of primary aluminum from bauxite was carried out. An overview of the aluminum industry and a detailed process analysis with particular emphasis on the energy requirements is followed by a brief look at future possibilities. Calcining of alumina at about 1150°C, electrolytic reduction of alumina to aluminum metal (approximately 950°C) requiring about 15,600 kWh/ton Al, and anode baking at 1100°C are identified as the most demanding processes. The alternative sources of aluminum, e.g., clays; the possibilities for energy conservation, such as recycling and the Alcoa chloride cell; and the dependence of the U.S. aluminum industry on imports are discussed. This analysis shows that present technology requires an average of over 16,000 kWh of electricity and 90 x 10^6 Btu of thermal energy, including fuel equivalents of anodes and cathodes consumed in the process, to produce one ton of aluminum ingot from bauxite.

6170 TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976). 285p. (CONF-7610153—P1). $30.00.

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

Thirty-six papers presented at the conference are included in this volume. A separate abstract was prepared for each of 16 papers. The remaining 20 papers were not in scope for the data base. (LCL)

6171 Conservation of lubricants in the pulp and paper industry. Tedrow, L.E.; Carlson, R.G.; Petrie, D.; Grode, R. pp 87-94 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

Conservation of lubricants and improvement of our environment have become commonplace goals both in the paper industry and our society today. Conservation of lubricants does not just happen but must be accomplished by careful planning and supervision. This paper stresses the importance of an organized lubrication program as the backbone in a lubricant conservation program and discusses the specific areas in the program as to when and how lubricant life can be extended. Also included is a detailed discussion on lubricant decontamination and suggestions for extending oil life in the paper industry.

6172 TAPPI conference papers: 1976 engineering. Book 2. Atlanta; Technical Association of the Pulp and Paper Industry (1976). 177p. (CONF-7610153—P2).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

Twenty-seven papers presented at the conference are included in this volume. A separate abstract was prepared for each of 5 papers. The remaining 22 papers were not in scope for the data base. (LCL)

ENERGY SOURCES

REFER ALSO TO CITATION(S) 5721, 6041, 6048, 6112, 6114

6173 (CONF-780801—30) **Reliability estimation for multiunit nuclear and fossil-fired industrial energy systems.** Sullivan, W.G.; Wilson, J.V.; Klepper, O.H. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The purpose of this paper is twofold: to report industrial experience with process energy system reliability, and to assess the reliability of multiunit nuclear and fossil-fired energy systems in an industrial setting. Reliability here refers to the percentage of clock time that sufficient amounts of steam energy were available to permit desired production quotas to be met at a particular plant. A nationwide survey was conducted to obtain data relative to energy system reliabilities during 1973—74, and these data for 29 plants from chemicals and allied products (S.I.C. 28), petroleum refining and related industries (S.I.C. 29) and primary metals industries (S.I.C. 33) are reported here. A simulation model in which various operating characteristics of the energy systems were taken into account was developed to obtain estimates of reliabilities of proposed multiunit nuclear and fossil-fired systems. Based on several example problems evaluated with the simulation model, study results indicated that multiple nuclear units or a combination of nuclear and fossil-fired units could provide adequate reliability to meet large-scale industrial requirements for continuity of service.

6174 (CONF-780801—34) **Conversion to coal in the industrial sector: a study of the problems and potential solutions.** Fox, E.C.; Anderson, T.D. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

The important factors that restrict the wide acceptance of direct coal combustion in industry and some possible approaches to overcoming these barriers are considered. Environmental and financial barriers are considered, as well as the economic comparison of the alternatives. The economic analysis explores the effect that size, coal quality and region of the country has on the incentives for an industrial steam user to convert to a coal combustion system. The proposed federal fuel taxes and investment tax credits are also examined to determine their effect on the decision. The results indicate that at least for the near term, wholesale conversion of industry from oil and gas to coal combustion does not appear to be forthcoming. The lack of substantial economic incentives, increased risk due to intensified capital requirements and the lack of a consistent environmental policy leads industry to postpone any energy decisions. Industrial boiler fuel taxes and tax credits will motivate some of the large steam users to convert. However, for the small and medium size users, incentives are lacking and the risks are too high. The second portion of this paper reports the evaluation of two potential solutions to the barriers identified. These are a central generation complex to provide steam to multiple industrial users, and an area coal terminal which provides coal handling, processing, and distribution services for dispersed users. The results indicate that these concepts provide an additional incentive for industrial steam users to convert to coal and appear to be promising for certain regions of the country.

6175 (CONF-7710136—, pp 160-167) **Reducing electrical power demand for industries.** Hegler, B.E. (Univ. of Missouri, Rolla); Nelson, J.B.; Harrell, R.O. 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

A typical industry has an electric power demand that is in excess of its needs. This condition places an unnecessary burden upon the industry and contributes to the current energy crisis. Reduction of demand may be accomplished by a number of methods of control that are examined and evaluated. Standard techniques of engineering analyses and engineering economy have been used to study and analyze an industry selected as an example.

6176 (ORNL/CON—33) **Energy demand and fuel choices in the pulp and paper industry.** Chern, W.S.; Just, R.E.; Caudill, S.B. (Oak Ridge National Lab., TN (USA)). Oct 1978. Contract W-7405-ENG-26. 36p. Dep. NTIS, PC A03/MF A01.

This report presents a generalized market-share model in which the restrictive constraints on cross-price coefficients need not be imposed yet in which all demand elasticities are uniquely determined. The model is applied to estimating aggregate energy demand and fuel choices for the pulp and paper industry. The structural equations are estimated by a generalized least squares procedure using state-level census data for 1971 and 1974. The econometric results support the argument that price coefficients should not be constrained. Furthermore, the "third-price" coefficients are statistically significant in the fuel-split equations. The empirical results show that the aggregate demand for purchased boiler fuels in the paper industry is responsive to changes in energy prices. Also, the market shares of boiler fuels are highly dependent upon their prices; the own-price elasticities are all considerably greater than unity. These results, along with several large cross-price elasticities, suggest that the possibility of interfuel substitution is rather strong in the paper industry. The market share elasticities estimated in this study are used in the economic/engineering simulation model of energy use in the paper industry being developed at the Oak Ridge National Laboratory for the Department of Energy.

6177 Kinetics of coke reduction of molten slag rich in iron oxide. Borgianni, C. *Ironmaking Steelmaking;* **5**: No. 2, 61-66(1978).

The kinetics of the reduction by coke of slags rich in iron oxide are described.

6178 Direct reduction of iron ore pellets with carbon in a rotary kiln simulator. Morrison, A.L. *Ironmaking Steelmaking;* **5**: No. 1, 32-38(1978).

Laboratory tests to ascertain the effects of processing variables on the reduction of iron ore pellets were carried out using char made from Australian coal as a reductant.

6179 Sponge iron in steel's future. Rose, S. *Fortune;* **95**: No. 11, 106-110, 112-113(Jan 1977).

This article includes a description of the Lurgi direct reduction process as modified by Stelco, which uses sub-bituminous coal or lignite as reductant in a rotary kiln. The findings of a published economic comparison of the process with blast furnace reduction is criticized, and alternative figures are suggested on the capital cost of a blast furnace or rotary kiln.

MATERIALS

REFER ALSO TO CITATION(S) 6159

6180 More waste materials could be used in road construction, says OECD report. *Surveyor (N.Y.);* **151**: No. 4479, 3(13 Apr 1978).

An OECD study of 220 major types of waste materials used in highway construction in 12 OECD countries has shown that those with the greatest potential are wastes from mining, quarrying, and metallurgical industries.

6181 Fuel efficiency booklet. 4. Compressed air and energy use. London; Department of Energy ([nd]). 11p.

Information is presented to help those responsible for maintaining services in factories, buildings, and garages to obtain a better understanding of how to prevent waste and misuse of compressed

air, and save on energy costs. Compressed air equipment is intrinsically safe and can be stalled without damage. Approximately 10% of all electrical power used in industry is employed in compressing air; this is proof of its widespread usage, but it also evidence that economy in the energy used for this purpose would provide a worthwhile saving in overall energy consumption. Five main areas are examined as part of a planned program aimed at cutting the cost of compressed air. These areas are: optimum conditions for efficient compression; avoiding leaks and other wastage; efficient running of the air-driven equipment; using lower pressure; and recovering the heat of compression.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 5700, 6053, 6160, 6202, 6204

6182 (CONF-7706129—, pp 14p, Paper 18) **HVAC systems management: where have we been; where are we going.** Utesch, A.L. (Dallas/Ft. Worth Regional Airport, TX). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

Two things required to insure a strong future for the HVAC industry are: good user management and the continued existence of the free-enterprise system. The author stresses these points saying they are the keys to the future of the United States. He points out that the key ingredient to excellent management is measurability (measuring the service provided) and discusses its possible forms relative to HVAC systems management--availability, reliability, cost, and comfort. In a chart, the author offers his opinion of HVAC management before the energy crisis, what he sees happening now, and what he predicts will be happening in the future. (MCW)

6183 (CONF-7710136—, pp 1-6) **Energy conservation in ammonia production.** Gupta, Y.P.; Wilson, D.B. (New Mexico State Univ., Las Cruces). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

The Federal Energy Administration currently is considering energy conservation goals for the industry. This paper presents methods for chemical/petroleum industry to conserve energy. Ammonia production is used as an example. A Sankey diagram for ammonia production is given.

6184 (HCP/M8675—01) **Boiler efficiency improvement training seminars.** (KVB, Inc., Tustin, CA (USA)). Aug 1978. Contract EM-77-C-01-8675. 266p. Dep. NTIS, PC A12/MF A01.

In 1975 there were nearly 63,000 industrial-size boilers in use in the USA. Significant boiler fuel consumption and air pollution reductions could be affected by boiler tuneups to improve boiler efficiency. Materials developed on industrial boiler efficiency useable as training seminar instructor teaching aids and as boiler operator reference guides are presented. This manual on industrial boilers includes information on: combustion fundamentals; fuels; performance testing; efficiency calculations; procedures for improving efficiency; data reduction and presentation; air pollution considerations; maintenance factors; auxiliary equipment for increased efficiency; and financial evaluation procedures. The data sources used for compiling this information are specified. (LCL)

6185 Fuel conservation controller for capacity controlled refrigeration apparatus. Lamb, J.W. US Patent 4,090,372. 23 May 1978. Filed date 21 Mar 1977. 16p.

A control system capable of controlling the refrigeration capacity of a refrigeration system adapted for cooling a fluid medium is described. The refrigeration system includes a refrigerant; an absorbent having an affinity for the refrigerant; an evaporator for bringing the refrigerant into heat transfer relationship with the fluid medium, the evaporator having an inlet for receiving the fluid medium to be cooled in an outlet for discharging cooled fluid medium; an absorber in communication with the evaporator for removing refrigerant vapor therefrom; means for supplying a concentrated absorbent-refrigerant solution to the absorber; means for cooling the absorber to maintain the pressure therein below the pressure in the evaporator whereby refrigerant vapor migrates to the absorber to combine with the concentrated solution to produce a dilute solution; a concentrator for removing a portion of the refrigerant from the dilute solution for recirculation to the evaporator and for providing the concentrated solution; means for supplying the dilute solution to the concentrator; and means for controlling the concentration of the concentrated solution supplied to the absorber for controlling the refrigeration capacity of the refrigeration system. Control system includes means disposed for sensing the variations in temperature at the evaporator inlet and outlet and within the absorber for providing first, second and third tracking signal outputs indicative of the sensed temperature variations, the first tracking signal output being indicative of the variations in temperature of the fluid at the evaporator outlet and the third tracking signal output being indicative of the variations in temperature in the absorber.

6186 Digital process control system monitors tissue machine energy consumption. Woolums, L.L. (American Can Co., Halsey, OR). pp 237-241 of TAPPI conferene papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

Most pulp and paper mills have effectively reduced energy consumption by instituting rigorous energy conservation programs. These programs have achieved savings through improved energy management brought about by continuous monitoring and reporting of energy flows; by minimizing distribution losses; and recovering and reusing waste heat. With the success of these and other conservation measures, mills are now directing their efforts toward improving machine and process efficiencies to maintain production with less energy. How a process computer, controlling basis weight and sheet moisture on a 4000 fpm tissue machine, saves energy by effecting tighter control over these variables is discussed. An added feature is a computer energy frame used to totalize instantaneous energy input and, more importantly, provide machine operators with continuous readout of energy consumed per unit of production.

6187 Continuous digester corrosion evaluation and welding overlay experience. Jacobs, R.H. (Factory Mutual Research Corp., Norwood, MA); Rienhoff, H.Y. pp 113-119 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The sixth report on results of the continuing survey under TAPPI CA 4198 again shows that corrosion and erosion of continuous digester shells is not a major problem as it is with many batch digesters. Stainless steel weld overlay, where it has been applied in continuous digesters, is holding up well. Most of the maintenance problems with continuous digesters involve auxiliary equipment, especially high- and low-pressure feeders, piping and valves. Overlay welding with stainless steel continues as the most successful means of extending the service life of batch digesters in which corrosion and/or erosion is a serious problem. In most cases the overlay is holding up well requiring a minimum of maintenance.

6188 Recovery boiler throughput and efficiency control. Shigemura, M.S. (Measurex Corp., Cupertino, CA). pp 127-131 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

In recent years the increased cost of energy and pulp has justified the use of computer control on a pulp mill recovery boiler. A control system has been developed to increase steam production by improved combustion control, increased heat utilization in evaporators and stabilized operation achieved by improved control strategies. In pulp mills where chemical recovery is the mill's bottleneck, the computer control system can increase pulp production by increasing the black liquor throughput rate in the recovery boiler. This is achieved by increasing the production rate while constantly monitoring boiler constraints. All boiler variables which constrain production rate are controlled in a manner that they approach their operating constraints as production rate is increased.

6189 Water treatment for boiler operating pressures above 1200 PSIG. Limon, L. (Ecodyne Corp., Union, NJ). pp 136-139 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

It is well accepted today that high pressure boilers require very high quality feedwater. Normally, boiler feedwater is about half makeup, half condensate. Typical makeup demineralizers required for different water supplies are described. Alternative types of equipment for treatment of condensate are discussed. Present day needs of high reliability, extremely high chemical costs, as well as high initial costs, demand very careful study of alternative methods of treatment.

6190 Internal treatments for boilers operating above 1200 PSI. Christiansen, B.; Hoefs, C.R. (Nalco Chemical Co., Oak Brook, IL). pp 140-142 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

Because of increased selection of higher pressure (+1200 psig) boilers by industry, new water treatment problems and challenges have occurred. New problem areas with high pressure boiler systems are discussed. Case histories illustrating problem solving techniques and results achieved are included.

6191 Reduction of energy costs through optimum application of press felts. Antos, D.P. (Huyck Felt, Rensselaer, NY). pp 57-62 of TAPPI conference papers: 1976 engineering. Book 2. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

Historically, it has been more economical to remove water in the press section rather than evaporating it in the dryer section. Results of recent pilot machine studies to develop felts with high water removal efficiency are confirmed by performance on production paper machines. Several examples are given and one such long range field study relates economic benefits of lower dryer steam usage to the lower sheet consistencies obtained with specially designed press felts.

6192 Design of convective dryers for best efficiency and productivity. Gardiner, F.J. (Honeycomb Systems, Inc., Biddeford, MN). pp 71-78 of TAPPI conference papers: 1976 engineering. Book 2. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The recent escalation in the cost of all forms of energy can be expected to be followed by further increases. Therefore, our continued interest in energy efficiency is well justified. The purpose of this paper is to achieve a better understanding of the trade-offs and methods needed to improve energy utilization. Unfortunately, some erroneous articles have found their way into the literature which needs to be corrected. This paper is limited to convective dewatering which includes water removal by vacuum or air pressure. An analysis is presented to show how the economic energy limits of this form of de-watering may be determined. Thermal convective drying includes high velocity impingement, floater dryers and through dryers. The basic relations for efficiency and effectiveness of all such dryers are presented. The importance of heat transfer coefficient to energy consumption and machinery size is demonstrated. The effect of temperature and air humidity is also deduced. The choice of fuel and the use of heat exchangers and/or economizers are examined. Indirect heating is evaluated against direct firing. The state of the art as well as some new relations for calculating heat transfer coefficients are presented.

6193 Energy considerations in paper machine design. Ely, D.A. pp 113-120 of TAPPI conference papers: 1976 engineering. Book 2. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

An overall look is given of the energy and water requirements of paper machines. A comparison is shown between increased equipment costs and savings in energy costs. Comparisons are given using lower cost steam (lower pressure) versus the cost of installing more dryers. Recommendations are made for energy and equipment combinations for the lowest overall cost.

6194 Energy trade-off in press felt conditioning. DeCrosta, E.F. (Albany Felt Co., NY). pp 121-124 of TAPPI conference papers: 1976 engineering. Book 2. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The techniques available to papermakers for increasing the amount of water removed from a web of paper are enumerated in this article. Two of those techniques—press felt conditioning and increased press loading are compared. An expression for "the power required for drying" is developed in the Appendix. An estimate of the major energy uses for press felt conditioning is compared to the "expected" energy savings associated with the combined use of increased press loading and felt conditioning. The conclusion is made that the energy costs for felt conditioning are small compared to the savings realized in the dryer section.

6195 Fuel efficiency booklet. 3. Utilization of steam for process and heating. London; Department of Energy ([nd]). 32p.

The simple physical principles of steam generation, steam usage, and heat transfer are reviewed. What can happen and what should happen to the heat in the steam supplied by the boiler are discussed in detail. Sources of heat loss from steam carrying pipes are discussed and how these losses may be reduced by lagging and preventing steam leakage is reviewed. The amount of work to be done by the steam in heating and process plants is shown. Measures to reduce losses by radiation from steam-using equipment are discussed and a variety of ways for making use of the sensible heat in hot condensate is examined. (MCW)

6196 Fuel efficiency booklet. 1. Energy audits. London; Department of Energy ([nd]). 12p.

The reasons why a company should carry out an energy audit are discussed. The approach used is very general since no two energy users employ energy in precisely the same way. An audit of any kind needs to be expressed in measurements, and since energy costs money, the final form of an energy audit will normally be expressed in energy and money units. This booklet is aimed not only at the managing director but also at the management accountant and the engineer who ideally should work together to produce the audit for presentation to top management. The procedures to follow for conducting an energy audit are outlined in detail.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 5672, 5714, 6035, 6036, 6048, 6195

6197 (ANL/EES-CP—16) Utilization of waste heat from energy conversion and industrial processes. Evans, A.R.; Hamilton, R.W. (Argonne National Lab., IL (USA)). [nd]. Contract W-31-109-ENG-38. 38p. (CONF-770898—1). Dep. NTIS, PC A03/MF A01.

From Energy technology; Northfield, MN, USA (15 Aug 1977).

The laws of thermodynamics state that no process of energy transformation can take place with perfect efficiency—some waste heat is always produced. The generation of waste heat from energy conversion and industrial processes are discussed. First-law and second-law efficiencies are defined. After listing the amounts of waste heat produced, some technological options for reducing waste heat or using it for other purposes, such as district heating, are described.

6198 (CONF-780801—31) Thermal energy storage for industrial waste heat recovery. Hoffman, H.W.; Kedl, R.J.; Duscha, R.A. (Oak Ridge National Lab., TN (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1978. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Portions of document are illegible.

An examination of the potential for energy conservation in five industrial categories has been completed under the first phase of a DOE study into the recovery and reuse of industrial waste heat through thermal energy storage. These five industries--aluminum, cement, food processing, paper and pulp, and iron and steel--represent only a part (albeit a significant part) of the total potential for energy savings. A possible savings of more than 15×10^6 bbls oil/yr appears possible. Some of this savings (about 4×10^6 bbl/yr) could be available in the near term (1 to 2 yrs) at moderate costs; demonstration for recovery of the remainder, being dependent on further technology development and significant capital investment, appears feasible on a 10-yr time scale. Other categories consuming more than 2% of the total national industrial energy usage (e.g., electronics and electrical equipment, glass, petroleum and coal, plastics, rubber, and textiles) must still be considered before a picture of the total energy savings potential in the industrial sector can be fully developed.

6199 Heat recovery means for drying apparatus. Leigh, B.R. (to Josglade Ltd.). US Patent 4,091,547. 30 May 1978. Priority date 31 Mar 1976, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A heat recovery means in drying apparatus such as a kiln is described. The equipment consists of a heat exchanger located at the moist air outlet of the chamber of the drying apparatus for contact with exhaust moist air therefrom and a further heat exchanger located at the air inlet to the drying apparatus for contact of incoming air. The heat exchangers are connected in the circuit by pipework for the circulation of the refrigerant between them in conveying heat energy by vaporized refrigerant from the heat exchanger located at the moist air outlet to that located at the inlet for transfer of said heat energy on condensation of the refrigerant to air entering the inlet.

6200 Increased preheating of sulfur plant gases. Reed, R.L.; Palm, J.W.; Ruth, R.G. (to Standard Oil Co. (Indiana)). US Patent 4,088,744. 9 May 1978. Filed date 18 Apr 1977. 6p.

The heat extraction or reclamation system particularly adapted to recover otherwise rejected heat from the refrigerant gas flowing through air conditioning and refrigerating systems includes a counter-flow heat exchanger for transferring heat to a medium such as water, the heat exchanger being installed in the tubing upstream of the conventional condenser. The heat extraction system has a pump for circulating water or other medium to be heated, located on one side of the heat exchanger. Hot refrigerant gas, the

so-called superheated gas flowing from the compressor of the air conditioning or refrigerating system, is circulated through the other side of the heat exchanger. The pump flow rate and the heat transfer area between the refrigerant gas and the water or other medium are chosen to ensure that the refrigerant gas outlet quality remains within limits which ensure flow continuity in operation. Refrigerant gas leaving the system will contain some liquid in the form of droplets or a small stream. The water temperature is maintained within limits by stopping the pump when the inlet water temperature reaches a predetermined maximum value. Refrigerant velocity through the heat exchanger is reduced compared to velocity at compressor discharge in some embodiments to lengthen residence time in the heat exchanger sufficiently to increase heat transfer from the refrigerant gas and yet provide an excess quantity of heat in the refrigerant gas compared to the heat removal capacity of the flowing water.

6201 Fuel efficiency booklet. 9. How to make the best use of condensate. London; Department of Energy ([nd]). 16p.

The more efficient use of heat from energy sources in the form of steam or hot water is discussed. Steam is generated in the boiler and distributed to provide the heat requirements of the processing or heating plant. In giving up its heat, the steam condenses but still retains some of the heat originally put into it by burning fuel in the boiler. Methods for recovering and using this heat are discussed.

6202 Fuel efficiency booklet. 6. Flash steam and vapour recovery. London; Department of Energy ([nd]). 13p.

Practical examples of the economies that can be made by the use of flash steam and vapor recovery are given. How much flash steam is available under various operating conditions is tabulated (Imperial and SI Units). What to do with the flash steam, some typical examples of flash steam-recovery, how to control the flash steam pressure, size of flash vessel, pumping hot condensates, and simple vapor recovery are discussed. (MCW)

6203 Fuel efficiency booklet. 2. The sensible use of latent heat. London; Department of Energy ([nd]). 12p.

Methods by which it is possible to make large economies in all kinds of steam-using plants by the simplest of re-arrangements are presented. The savings described may require alterations to the plant, but once these alterations are done the savings go on without supervision. Improving the efficiency of the boiler house, on the other hand, although requiring no plant alterations, calls for tireless effort and supervision. Latent heat and sensible heat, reducing the demand for heat, heat insulation (lagging), and making use of residual heat are specific subjects discussed. Some measures to quickly check in-process methods and storekeeping steam are suggested. (MCW)

6204 Fuel efficiency booklet. 5. Steam costs and fuel savings. London; Department of Energy ([nd]). 13p.

Recommendations for the works and services engineer and the cost accountant, energy manager, and the industrialist are presented. The majority of processing and manufacturing industries utilize steam, compressed air, and electric power. The basic requirements of these services are pointed out, specifically steam costs. Cost of steam, metering, and evaluating savings (calculation of the fuel saved and fuel savings by reduction in steam demand) are discussed. A checklist deserving attention is included for storekeeping steam; steam distribution; process methods; condensate and air removal; and flash steam, condensate, and waste heat recovery. (MCW)

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 5074, 5075, 5716, 6448

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 5668, 6033, 6037

6205 (CONF-771203—, pp 737) **Reading the energy meter on development.** Mahony, P.; Rainer, G. (Conklin and Rossant and Flack and Kurtz, New York). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

CONSERVATION SERVICES

REFER ALSO TO CITATION(S) 5473

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 5701, 6032, 6034, 6036, 6039, 6042

6206 (CONF-771203—, pp 747-748) **Evaluation for the potential of district heating in the United States.** McDonald, C.L. (Battelle-Northwest, Richland, WA). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 6402, 6595

6207 Easing of the raw material and primary energy balance of the Federal Republic of Germany by recycling the metallic portion of household refuse. Turowski, R. *Metall;* **32**: No. 5, 498-500(May 1978). (In German).

The contribution is compiled of excerpts from a lecture during the 6th Waste Management Seminar at the Technical University of Berlin from 3-7 April 1978, and from a thesis by the author at the University of Essen, published also as report No. 1453 by the Kernforschungsanlage Juelich. Assessed and specified are (1) quantity and break-down of refuse in the Federal Republic of Germany; (2) conservation of metallic raw materials by recycling domestic refuse; (3) potential and recycling rate of aluminium and (4) easing the energy balance in general and the energy consumption in connection with aluminium in particular.

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 6062

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 6228, 6230

6208 Non-air breathing option for an internal combustion engine. Baldwin, R.J. US Patent 4,091,769. 30 May 1978. Filed date 25 Feb 1977. 4p.

An internal combustion engine is described that has an auxiliary monopropellant fuel supply for operation where reliance on atmospheric air for support of combustion would be undesired or not feasible. The auxiliary monopropellant fuel system includes a fuel selector valve for disconnecting supply of hydrocarbon fuel and an air cutoff valve for closing the engine cylinder air intake.

6209 Supercharged internal combustion engine. Dorsch, H. (to Porsche AG). US Patent 4,091,620. 30 May 1978. Priority date 17 Sep 1975, German, Federal Republic of (F.R. Germany). 8p.

A supercharged internal combustion engine is described that has an exhaust gas turbocharger which includes an exhaust gas turbine and a charging blower driven by the exhaust gas turbine. A secondary air pump is associated with the internal combustion engine for afterburning of the exhaust gases with a regulating valve, controlled by the combustion air pressure, being effective to supply secondary air from the secondary air pump into either the exhaust gas line upstream of the exhaust gas turbine or discharging of the secondary air into the atmosphere in dependence upon the combustion air pressure.

6210 Injection device for injecting an additional, small fuel quantity into an external auto-ignition internal combustion engine operating according to the stratified-charge principle. Rapp, W.; Schmidt, D. (to Daimler-Benz AG). US Patent 4,091,771. 30 May 1978. Priority date 22 May 1974, German, Federal Republic of (F.R. Germany). 10p.

An injection device is described for injecting fuel into a combustion space such as an auxiliary combustion space of an external auto-ignition internal combustion engine of the type operating on the stratified-charge principle. The injection device includes a housing accommodating a movable pump plunger, a movable nozzle needle controlling the nozzle orifice opening into the auxiliary combustion space, and a movable piston-type storer. The pump plunger is configured to close off respective fuel return and fuel

supply lines during its pumping stroke, at which time it effects a buildup of pressure resulting in movement of the piston type storer until a predetermined sufficient pressure is reached to force the nozzle needle away from the closed position to thereby effect injection of fuel into the auxiliary combustion space. An adjustable stop is provided at the piston-type storer and the supply fuel to the fuel supply line is under an adjustable pre-pressure, whereby the adjusted pre-pressure and the configuration of the piston-type storer control the amount of fuel injection.

6211 Internal combustion engine with delayed torch ignition of oil fuel charge. Heater, W.R.; Schaub, F.S.; Kennedy, J.R. (to Cooper Industries, Inc.). US Patent 4,091,772. 30 May 1978. Filed date 14 May 1976. 6p.

A primarily oil-fueled engine is disclosed in which the engine compression ratio is established well below the level at which compression ignition of oil fuel will occur and in which the oil fuel charge is ignited by the discharge from a spark ignited, gas-fueled precombustion chamber. The compression ratio and peak firing pressures are similar to those encountered in a gas-fueled engine.

6212 Stratified combustion type engine. Kamiya, M. US Patent 4,091,774. 30 May 1978. Priority date 5 Dec 1973, Japan. 4p.

A stratified combustion type engine is described that is comprised of an engine cylinder, a main combustion chamber located above the cylinder, an injection nozzle for injecting auxiliary fuel towards the combustion chamber, and an open pre-combustion chamber provided within the combustion chamber for locally holding and vaporizing the flow of auxiliary fuel from the injection nozzle. The pre-combustion chamber is internally equipped with a spark plug.

6213 Fuel injection pump with cavitation preventing steps along the fuel return flow path. Bastenhof, D. (to Societe d'Etudes de Machines Thermiques). US Patent 4,090,819. 23 May 1978. Priority date 5 Nov 1975, France. 8p.

A means of damping cyclic fuel injection pressure drop in a constant-stroke, variable delivery flow rate injection jerk-pump for an internal combustion engine is described that consists of slowing down fuel pressure drop at the end of every injection cycle by increasing the added pressure head losses of fuel backflow by a reduction of the free passageway cross-sections through which the fuel flows successively on its return path from the pump working chamber to the spill port.

SPARK-IGNITION

6214 (UCRL—80593) **Lean limit combustion in an expanding chamber.** Smith, O.I.; Westbrook, C.K.; Sawyer, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1978. Contract W-7405-ENG-26. 13p. (CONF-780806—3). Dep. NTIS, PC A02/MF A01.

From 17. symposium on combustion; Leeds, UK (20 Aug 1978).

Incomplete combustion of methane-air mixtures in the bulk gas, as opposed to the wall boundary layer, due to chamber expansion was observed over the equivalence ratio range 0.563 greater than phi greater than or equal to 0.615. Experimental observations and corresponding numerical calculations indicate that the unburned gas density plays a critical role in the process. Thus, the point of "bulk quenching" is dependent on the amount of volume expansion and is found to be nearly independent of the rate of chamber expansion. Flame stretch is found to contribute to the process for flame kernel Karlovitz numbers greater than 0.15, indicating that bulk quenching is likely to assume greater importance relative to other means of flame extinguishment as ignition timing is retarded.

DIESEL

REFER ALSO TO CITATION(S) 6229

TURBINE

REFER ALSO TO CITATION(S) 6226, 6231

6215 Fuel control. Linebrink, K.L.; Stearns, C.F. (to Dept. of Energy). US Patent Application 244,080. 14 Apr 1972. 11p.

A fuel control for a gas turbine power plant adapted for automotive use includes an open loop scheduling control for acceleration which varies the pressure drop across the metering orifice as a function of W/sub f//P_3 (W/sub f/ = fuel flow in pounds/hours, P_3 = compressor discharge pressure in pounds/square inch absolute) and varies the area of said metering orifice as a function of P_3 divided by another engine operating parameter such as turbine exhaust temperature to effectuate multiplication of the W/sub f//P_3 and P_3 values for establishing the value of W/sub f/, where W/sub f//P_3 is scheduled by the foot pedal position.

ROTARY

6216 Stratified charge fuel injection system for rotary engine. Jones, C. (to Curtiss-Wright Corp.). US Patent 4,091,789. 30 May 1978. Filed date 11 Feb 1977. 6p.

The improved stratified charge fuel system for a rotary engine has a fuel nozzle for injecting fuel into each engine working chamber coacting with an igniter at a common recess opening into the engine working chambers to ignite the fuel discharging from the nozzle. The improvement comprises heat retention means for the common recess so that the walls thereof become relatively hot and thereby promotes evaporation of the fuel discharging from the fuel nozzle.

6217 Experimental and theoretical analysis of Wankel engine performance. Danieli, G.A.; Keck, J.C.; Heywood, J.B. Warrendale, PA; Society of Automotive Engineers, Inc. (1978). 23p. (CONF-780208—66).

From Society of Automotive Engineers International Automotive Engineering Congress and Exposition; Detroit, MI, USA (Feb 1978).

A model for predicting the performance and emissions characteristics of Wankel engines has been developed and tested. Each chamber is treated as an open thermodynamic system and the effects of turbulent flame propagation, quench layer formation, gas motion, heat transfer and seal leakage are included. The experimental tests were carried out on a Toyo Kogyo 12B engine under both motoring and firing conditions and values for the effective seal leakage area and turbulent heat transfer coefficient were deduced. The agreement between the predicted and measured performances was reasonable. Parametric studies of the effects of reductions in seal leakage and heat transfer were carried out and the results are presented.

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

6218 (COO—4396-1) **Automotive Stirling Engine Development Program. Quarterly technical progress report, October—December 1977.** Kitzner, E.W. (Ford Motor Co., Dearborn, MI (USA)). Jan 1978. Contract EC-77-C-02-4396; EC-77-A-31-1040. 98p. (NASA-CR—135331). Dep. NTIS, PC A05/MF A01.

This report covers the first 3 months effort of the Ford/DOE Automotive Stirling Engine Development Program, specifically Task I which is Fuel Economy Assessment. At the beginning of this contract effort the projected fuel economy of the 4-215 Stirling engine was 21.16 MPG with a confidence level of 29 percent. Since that date, the fuel economy improvement projection of the 4-215 Stirling engine has been increased to 22.11 MPG, with a confidence level of 29 percent. Collection of fuel economy improvement data is directly related to engine durability. Engine durability has been limited. Since September 19, 1977 a total of 47.7 hours of engine running time has been accumulated using two engine builds. Progress is reported in sub-task studies of burners, preheaters, engine drive, blower system, power control, air-fuel ratio control, cooling system, and cycle control. (LCL)

6219 Engine driven heating system components for Stirling engines. Reams, L.A.; Geddes, A.E. (to Ford Motor Co.). US Patent 4,096,695. 27 Jun 1978. Filed date 3 Mar 1977. 6p.

A mechanical drive system permits a single electric motor to drive at least three rotary components necessary to the cold starting of a Stirling engine. These components comprise a rotary preheater, an air atomizing pump for facilitating proper injection of fuel particle size, and a combustion air blower, all necessary to heat the working gas of a Stirling engine prior to engine cranking. The drive system employs a shaft, offset from the engine driven element but drivingly connected thereto. A clutch is interposed between the offset shaft and the rotary starting components, as well as between the electric motor drive and said components. Thus, drive is alternatively transmitted, first from said motor to the component to permit engine temperature increase, cranking is then established, and then drive is transmitted from the engine driven element to said components.

RANKINE CYCLE

6220 (COO—2670-1) **Design and development of an automotive organic Rankine-cycle powerplant with a reciprocating expander. Final report. Volume II. Detailed discussion.** (Thermo Electron Corp., Waltham, MA (USA)). Sep 1977. Contract EY-76-C-02-2670. 333p. (TE—4157-72-78). Dep. NTIS, PC A11/MF A01.

Work performed for the design and development of an organic Rankine-cycle engine for automobile propulsion is reported. An automotive power plant using an organic Rankine-cycle system with a reciprocating expander has been designed, built, and tested on an

engine dynamometer in a preprototype configuration. The system is designed to provide performance approximately equivalent to that of a 351-CID internal combustion engine in the reference car, a 1972 Ford Galaxie 500. A description of the preprototype system, major components, and results from component and system testing are presented. The fuel economy based on steady-state measurements is estimated to be 10.2 mpg over the federal driving cycle with a maximum of 16 mpg at 30 mph. Projections of steady-state emission measurements show compliance with the 1970 Clean Air Act standards for 1978 vehicle emissions. The levels for unburned hydrocarbons, carbon monoxide, and oxides of nitrogen were 41 percent, 6 percent, and 69 percent of the standards, respectively. At the conclusion of the preprototype phase of the program, a prototype design effort was initiated to upgrade and improve the performance of the preprototype system. The reference vehicle for this prototype design is a compact car in the weight class of a 1974 Ford Pinto. The results of this design study, including performance projections, are also presented.

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 5995, 6014, 6030

6221 (CONF-771203—, pp 657-659) **Partial energy supply to electric vehicles through solar cell system.** Varde, K.S. (Univ. of Michigan, Dearborn). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6222 **Efficiency improvement of electric vehicles by regenerative braking.** Kasama, R.; Naito, S.; Katada, H.; Shibata, T. Warrendale, PA; Society of Automotive Engineers, Inc. (1978). 12p. (CONF-780208—80).

From Society of Automotive Engineers International Automotive Engineering Congress and Exposition; Detroit, MI, USA (Feb 1978).

Generally in electric vehicles regenerative braking is incorporated to increase urban driving range on a single charge and to get the same brake torque as engine brake. An analysis of the regenerative operation by thyristor chopper control is described. Firstly, to clarify regenerative efficiency, the calculation of various losses such as commutation loss and thyristor loss which arises at the braking mode is discussed. The regenerative efficiency calculated from the above losses agrees closely with test results. Secondly, a newly developed automatic field control (AFC) regenerative braking system is introduced. This AFC regenerative control system uses a shunt motor, the field current is controlled inversely proportional to motor speed and regenerative operation is obtainable by low motor speed. This system is suitable for electric vehicles. Thirdly, it is noted that utilizing this AFC regenerative brake control, actual urban driving range can be increased by approximately 16%.

6223 **Trolleybuses: economy, safety, comfort.** Polyakov, P.P. *Energoexport;* **4**: 25-26(1977).

There are 17,000 electric trolleybuses in Soviet cities exhibiting the key assets of this form of urban transport: noiseless operation, absence of toxic fumes, and good dynamic qualities. The design and operation of a recently introduced trolleybus model are described, and design specifications are tabulated. (PMA)

6224 (NP-tr—2022) **Comparison of a VW pick-up truck ("Transporter") with petrol engine and a VW electric pick-up truck.** Altendorf, J.P.; Kalberlah, A.; Saridakis, N. Translated from *Elektrotech. Z., A;* **94**: No. 11, 666-671(1973). 21p. British Library Lending Div., Yorkshire, Eng.

An electro-transporter was designed on the basis of the relationship between the total weight of the vehicle, the payload and the turning radius. A comparison is made with a VW Transporter as regards construction, performance and turning radius with and without regenerative braking. The feasibility of its use is discussed and a comparison of its economic characteristics is made.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 6014

VEHICLE DESIGN FACTORS

ENGINE-TRANSMISSION MATCHING

6225 (COO—2674-16) **Continuously variable transmission. Final technical report.** Hughson, D.; Emmadi, R.; Topouzian, A.; Lampinen, B.; Bhavsar, C. (Ford Motor Co., Dearborn, MI (USA)). Dec 1977. Contract EY-76-C-02-2674. 176p. Dep. NTIS, PC A09/MF A01.

Ford Motor Company over the past two decades has been studying various types of Infinitely Variable (I.V.) Transmissions for improving passenger car fuel economy. Of the traction drive mechanisms investigated, the Forster I.V. transmission appeared the most attractive because it reduces the complexity and manufacturing costs associated with other traction drives by virtue of its unique ratio-changing mechanism. Ford Motor Company was awarded contract E(11-1)-2674 on July 1, 1975 to study an infinitely variable traction drive transmission based upon the Forster Concept. The program plan was set-up in two phases. Phase I consisted of a design study, whereby the traction drive mechanism was experimentally and analytically evaluated and an I.V. transmission designed. Phase II, contingent on the outcome of Phase I, was to cover the build, vehicle evaluation and a manufacturing cost study. Testing and stress analysis of the flexible discs proved that the concept was not a feasible design, therefore Phase II (transmission build) was not recommended. In an effort to obtain baseline data on traction coefficients and efficiencies of traction drive transmissions a contract extension was awarded. Rigid discs with fixed geometry were designed to develop this data.

ENGINE SYSTEM

REFER ALSO TO CITATION(S) 6215

EMISSION CONTROL

REFER ALSO TO CITATION(S) 6220

6226 (DOE/NASA/1040—78/3) **Effect of inlet temperature on the performance of a catalytic reactor.** Anderson, D.N. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1978. Contract EC-77-A-31-1040. 18p. (NASA-TM—78977). Dep. NTIS, PC A02/MF A01.

A 12-cm diameter by 15-cm long catalytic reactor was tested with No. 2 diesel fuel in a combustion test rig at inlet temperatures of 700, 800, 900, and 1000°K. Other test conditions included pressures of 3 and 6 x 10^5 Pa, reference velocities of 10, 15, and 20 m/s, and adiabatic combustion temperatures in the range 1100 to 1400°K. The combustion efficiency was calculated from measurements of carbon monoxide and unburned hydrocarbon emissions. Nitrogen oxide emissions and reactor pressure drop were also measured. At a reference velocity of 10 m/s, the CO and unburned hydrocarbons emissions, and, therefore, the combustion efficiency, were independent of inlet temperature. At an inlet temperature of 1000°K, they were independent of reference velocity. Nitrogen oxides emissions resulted from conversion of the small amount (135 ppM) of fuel-bound nitrogen in the fuel. Up to 90 percent conversion was observed with no apparent effect of any of the test variables. For typical gas turbine operating conditions, all three pollutants were below levels which would permit the most stringent proposed automotive emissions standards to be met. The pressure drop increased linearly with reference velocity and decreased slightly as the inlet temperature was raised. Pressure drop increased linearly with velocity to a maximum value of 1.5 percent at a reference velocity of 20 m/s.

6227 **Internal combustion engine having exhaust emission control system.** Mori, H. (to Fuji Jukogyo Kabushiki Kaisha). US Patent 4,099,497. 11 Jul 1978. Priority date 26 Dec 1974, Japan. 16p.

The characteristics of an exhaust emission control system can be varied by bleeding air into a vacuum conduit through which a vacuum is applied to a vacuum actuator in the exhaust emission control system. Means for bleeding air into the vacuum conduit includes at least one replaceable orifice. Another ambient air bleeding means comprises three plates which are joined face to face to one after another to form internal fluid connections between pressure and vacuum conduits through which intake passageway vacuum is applied to a vacuum actuator in an exhaust emission control system. One of the three plates is formed with a plurality of air bleed control orifices and can be easily replaced with another one.

6228 **Catalyst container for use in exhaust manifold.** Nohira, H.; Bessho, H.; Sakai, Y. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,096,691. 27 Jun 1978. Priority date 4 Jun 1975, Japan. 6p.

A catalyst container is described for use in an exhaust manifold. The container includes perforated inner and outer cylinders and is positioned within the exhaust manifold, in the position of its exit, with catalysts filled in a cylindrical space defined between the inner cylinder and outer cylinder. In this catalyst container, annular openings in the cylindrical space at its top and bottom ends are covered with annular upper and lower lids, respectively, while a circular, inner cylinder lid is placed over the top opening of the inner cylinder to cover it. In addition, an outer cylinder lid is placed on the top circumferential edge of the outer cylinder in a manner to cover the top opening of the outer cylinder as well as the circular, inner cylinder lid. The catalysts are filled in a first space defined by the inner cylinder lid and the outer cylinder lid as well as in a second space defined between the outer cylinder and the inner cylinder. The first space communicates with the second space through at least one hole provided in the upper annular lid.

6229 Catalytic devices for treating exhaust gases of internal combustion engines. Loweg, H. (to Gewerkschaft Eisenhutte Westfalia). US Patent 4,091,616. 30 May 1978. Priority date 4 Mar 1975, German, Federal Republic of (F.R. Germany). 4p.

A catalytic device is described that is in the form of a manifold connectible to the engine block of an internal combustion engine to receive the exhaust gases. The manifold has an outer jacket for receiving coolant, e.g., water, and within this jacket is provided a chamber containing a catalyst cartridge serving to treat the exhaust gases to remove carbon monoxide therefrom. The cartridge is replaceable and has a pipe at one end which forms an exhaust pipe and a tubular projection into which the gases are passed. The cartridge is spaced from the inner surface of the chamber wall and is thermally insulated therefrom.

NITROGEN OXIDES

6230 Internal combustion engine with plural spark plugs for each combustion chamber and exhaust recirculation circuit. Hayashi, Y.; Kuroda, H.; Nakajima, Y.; Yoshimura, T. (to Nissan Motor Co., Ltd.). US Patent 4,091,615. 30 May 1978. Priority date 22 May 1975, Japan. 10p.

Each combustion chamber of an internal combustion engine is equipped with at least two simultaneously working spark plugs which are arranged distant from each other and located out of a central region of the combustion chamber, and an exhaust recirculation circuit including a flow control valve is arranged to recirculate exhaust gas to a nearly stoichiometric air-fuel mixture to be fed to the engine at a high recirculation rate on the maximum of 12 to 40% by volume of the quantity of air drawn into the engine.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 5424, 5426, 5427, 5428, 5429, 5430, 6208

6231 (CONF-771203—, pp 165-167) **Design of a coal-powered bus.** Purcupile, J.C. (Carnegie-Mellon Inst. of Research, Pittsburgh). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

MATERIALS

REFER ALSO TO CITATION(S) 5783

6232 (TID—28793) **Surface and catalysis science in the Materials and Molecular Research Division.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 57p. Dep. NTIS, PC A04/MF A01.

Summaries are presented for research performed in the areas of (a) studies of the atomic and electronic structure of surfaces and adsorbates, (b) studies of the catalysis of surface reactions, and (c) investigation of the grain structure and interface structure of solids. (GHT)

6233 Electrical transport and optical properties of inhomogeneous media. Garland, J.C.; Tanner, D.B. (eds.). New York; American Institute of Physics (1978). 427p. (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

In all, 52 papers were presented, including several comprehensive review papers. Separate abstracts were prepared for 15 papers and three were previously abstracted for EDB. (MHR)

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 4992, 4993, 4994

6234 (COO—4540-1(Vol.2)) **Technical assessment of vanadium-base alloys for fusion reactor applications. Volume 2. Review of properties: vanadium and vanadium-base alloys. Final report.** Gold, R.E.; Harrod, D.L.; Ammon, R.L.; Buckman, R.W. Jr.; Svedberg, R.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Apr 1978. Contract EC-77-C-02-4540. 295p. Dep. NTIS, PC A13/MF A01.

Separate abstracts were prepared for each of the 5 included sections. (MOW)

6235 Scattering theory and effective medium approximations to heterogeneous materials. Gubernatis, J.E. (Los Alamos Scientific Lab., NM). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 84-98(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

The formal analogy existing between problems studied in the microscopic theory of disordered alloys and problems concerned with the effective (macroscopic) behavior of heterogeneous materials is discussed. Attention is focused on (1) analogous approximations (effective medium approximations) developed for the microscopic problems by scattering theory concepts and techniques, but for the macroscopic problems principally by intuitive means, (2) the link, provided by scattering theory, of the intuitively developed approximations to a well-defined perturbative analysis, (3) the possible presence of conditionally convergent integrals in effective medium approximations.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 5788, 6242, 6446

6236 (IS-M—134) **Determination of the energy gap in $Nb_{0.75}Zr_{0.25}$ using a proximity tunneling method.** Wolf, E.L.; Noer, R.J. (Ames Lab., IA (USA); Carleton Coll., Northfield, MN (USA)). 1978. Contract W-7405-ENG-82. 8p. (CONF-780824—12). Dep. NTIS, PC A02/MF A01.

From 15. conference on low temperature physics; Grenoble, France (23 Aug 1978).

A well defined structure in the tunneling density of states N/sub T/(E) for junctions of the form $In/Al_2O_3/AlNb_{0.75}Zr_{0.25}$ was observed. Observation determined $2\Delta/kT$/sub C/ = 4.1 at T/sub C/ = 10.7 K in $Nb_{0.75}Zr_{0.25}$. The method may be applicable to other superconductors which do not form a suitable thermal oxide tunnel barrier.

6237 (LBL—8000) **Increased strengthening of austenitic alloys through dual aging.** Ma, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 58p. Dep. NTIS, PC A04/MF A01.

Thesis.

A study of the effect of solution treatment, single and duplex isothermal aging heat treatments on an Fe-Ni-Ti-Al austenitic alloy hardened by γ' precipitation is reported. Sequential heat treatments were performed and studied in order to develop a systematic process for achieving very high strength austenite through thermal processing alone. Room temperature tensile tests were carried out. Alloys receiving double aging treatments were found to achieve mechanical properties superior to those aged at a given temperature. An optimum level of yield strength (172 Ksi) along with good elongation (20%) was obtained from a two-step aging process. Structural examination indicated that overaging was retarded by secondary aging. The formation and growth of cellular precipitates were suppressed. Resistivity changes were measured on wire specimens to study the early stages of precipitation. Resistivity peaks were observed during secondary aging indicating evidence of secondary precipitation.

6238 (RFP—2743) **Dislocation substructures in high-energy-rate-forged and press-formed 21-6-9 stainless steel.** Sanderson, E.C.; Brewer, A.W.; Krenzer, R.W.; Krauss, G. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 24 Jul 1978. Contract EY-76-C-04-3533. 22p. Dep. NTIS, PC A02/MF A01.

A Transmission Electron Microscope (TEM) was used to establish that the substructure of press formed (PF) 21-6-9 stainless steel toroids was characterized by a dislocation cell size finer, about 0.16 μm, than that of about 0.29 μm, of high-energy-rate-formed (HERF) processed toroids. In addition, HERF processed material

showed areas of a coarser, well-developed subgrain structure characteristic of hot work deformation. The formation of the substructures, as-well-as the grain size and carbide distributions of the toroids produced by the two processing techniques, are discussed in terms of the various operations, temperatures, and strain rates associated with the two different processing schedules. The Press-Formed toroid had a higher yield strength than the HERF processed toroid which was attributed to the finer cell size of the PF processed toroid.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 5976, 6236, 6249, 6254, 6277

6239 (CONF-780738—1) **Dislocations near the interface of electrodeposited copper and nickel single crystals.** Narayan, J.; Young, F.W. Jr. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 2p. Dep. NTIS, PC A02/MF A01.

From 4. conference on crystal growth; Gaithersburg, MD, USA (16 Jul 1978).

A new technique based on transmission electron microscopy has been used to study defects at and near the interfaces of epitaxial electrodeposits on copper and nickel single crystals. Thick (greater than 100 μm) single crystal epitaxial deposits of copper were made on (100), (111) and (123) surfaces of copper crystals using a sulphate bath, and of nickel on (100) surfaces of nickel crystals using the Watts plating bath. The electrodeposited specimens were sectioned normal to the interface and the areas near the interface were thinned for study by electron microscopy. (GHT)

6240 (CONF-780823—4) **Band theory approach for actinides.** Koelling, D.D. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 19p. Dep. NTIS, PC A02/MF A01.

From Conference on the electronic structure of the actinides; Grenoble, France (30 Aug 1978).

The application of band theory to actinide systems is investigated. The fundamental aspects are considered to define the limits of applicability. The more practical approximate applications are then considered to demonstrate their underlying assumptions and range of applicability. Examples are drawn primarily from our own work on Th α-U and UGe_3.

6241 (CONF-780823—7) **Studies of einsteinium metal.** Haire, R.G.; Baybarz, R.D. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From Conference on the electronic structure of the actinides; Grenoble, France (30 Aug 1978).

Thin films of einsteinium metal were prepared by reducing Es_2O_3 with lanthanum, distilling the einsteinium metal, and condensing it on carbon substrates supported by electron microscopy grids. The metal deposits were then analyzed by electron diffraction. The results show that vapor-deposited einsteinium metal is divalent and exhibits a fcc phase (a_0 = 5.75(1)A) very similar to that reported for the expanded form of californium metal.

6242 (HEDL-SA—1515) **Imaging of defects in austenitic stainless steel weldments.** Michaels, T.E.; Emmons, J.S.; Mech, S.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 1978. Contract EY-76-C-14-2170. 29p. (CONF-7805122—1). Dep. NTIS, PC A03/MF A01.

From 1. symposium on acoustical holography; Key Biscayne, FL, USA (30 May 1978).

Image analysis techniques are considered in order to develop a method of sizing and locating defect indications. The intent is to develop methods which can be used to accurately size and locate indications without being severely affected by the attenuation and scattering difficulties normally associated with stainless steel weld inspection.

6243 **Upper limit to equilibrium segregation at a grain boundary.** White, C.L. (Oak Ridge National Lab., TN); Stein, D.F. *Scr. Metall.;* **11**: 613-616(1977).

It is shown that the upper limit for equilibrium solute segregation at a grain boundary, as formulated by Cahn and Hilliard, is valid not only for Henrian behavior of the bulk solvent-solute system, but for behavior of the type described here. This behavior is shown to be satisfied for negative deviations from Henry's Law. This suggests that, while the criticisms of Bitler are valid for some classes of bulk thermodynamic behavior, the expression by Cahn and Hilliard does represent a valid upper bound in many other cases where detailed solution activity data may not be available.

6244 **Electroreflectance in metals.** Furtak, T.E.; Lynch, D.W. (Ames Lab., IA). *Nuovo Cim.;* **39B**: No. 2, 346-355(1977).

A brief outline of developments in the past ten years in the field of electromodulation spectroscopy of metals is given, emphasizing only those points the authors believe are important for future work in this field. Attention is directed primarily to the determination of modulation mechanisms in the metal.

6245 **Computation of isothermal sections of the Al—Li—Mg system.** Saboungi, M.L.; Hsu, C.C. (Argonne National Lab., IL). *Calphad;* **1**: No. 3, 237-251(1977).

The numerical method developed by Kaufman and Nesor is applied to calculate the phase diagrams of the binary systems Al—Li, Al—Mg and Li—Mg. Information on the thermodynamics of the solution as well as on the thermodynamics of the binary compounds are derived and, when available, compared with experimental results. Isothermal sections of the ternary system, Al—Li—Mg are estimated at temperatures of interest for the lithium battery developed at Argonne National Laboratory (T = 648, 673, 723 and 773 K). The calculations of these sections are based mainly on information derived from the analyses of the binary subsystems. Until further experimental evidence is obtained on the stability and existence of ternary compounds in the temperature range of interest any ternary compounds in the computations was included.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 5769, 5829, 5830, 6237, 6272, 6273, 6275, 6279

6246 (CONF-780834—2) **Microstructural observations on time-dependent failure in weld-deposited Type 16-8-2 stainless steel.** Raske, D.T.; Diercks, D.R. (Argonne National Lab., IL (USA)). 1978. Contract W-7405-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From 5. Bolton Landing conference; Lake George, NY, USA (27 Aug 1978).

Type 16-8-2 stainless steel weld metal is less resistant to rupture than Type 316 stainless steel base metal under monotonic creep conditions, but is substantially more resistant to failure under conditions of fatigue and combined creep and fatigue. Fractographic and metallographic analyses indicate that specimens from the two types of tests differ in failure modes. In monotonic-creep tests, the Type 16-8-2 weld-metal specimens failed by intergranular and interphase separation followed by microvoid growth and coalescence. Under creep-fatigue conditions, failure occurred by a mixture of matrix and interphase cracking, with substantial transgranular cracking present even for tests with a 1.8 x 10^{4} s (300-min) tension hold time per cycle. The present results indicate that the resistance of Type 16-8-2 weld metal to creep-fatigue failure is directly related to its resistance to grain-boundary and interphase cracking.

6247 (COO—4540-1(Vol.2), pp 58-194) **Mechanical properties of vanadium and vanadium-base alloys.** Apr 1978.

In Technical assessment of vanadium-base alloys for fusion reactor applications. Volume 2. Review of properties: vanadium and vanadium-base alloys. Final report.

The purpose of the present review is to compile, summarize, and interpret the existing mechanical property data on vanadium and vanadium-base alloys as an aid to the further assessment of vanadium alloys for fusion reactor first wall applications. No consideration is given to fabricability, corrosion resistance, or radiation effects; these issues are treated separately in other portions of this document.

6248 (LBL—7670) **Effect of austenitizing temperature upon the microstructure and mechanical properties of experimental Fe/Cr/C and Fe/Cr/C/Ti steels.** Carlson, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 62p. Dep. NTIS, PC A04/MF A01.

Thesis.

Increasing the austenitizing temperature from 870°C to 1100°C and higher can increase the fracture toughness, K/sub Ic/, of common high strength structural steels from 50 to 100% with no loss in strength. However, the ductility (% reduction in area from a tensile test) decreases by as much as a factor of 3, and the Charpy impact energy either decreases or remains constant. The trend of increasing fracture toughness and decreasing Charpy impact energy appears to be inconsistent, but has been rationalized by considering the interaction of the stress field as a function of notch root radius and the microstructure. The present study investigates the as-quenched strength and toughness of simple Fe/Cr/C alloys with and without titanium as a function of austenitizing temperature. For the ternary Fe/Cr/C alloys the results are consistent with earlier investigations, but the fracture toughness does not change with increasing austenitizing temperatures after 0.2 wt % Ti is added. The titanium forms carbides (TiC) that did not dissolve, providing a roughly constant number of crack nucleation sites, and preventing austenite grain growth up to 1100°C. The differences in mechanical behavior, particularly the rounded notch toughness, are discussed and explained in terms of the microstructural characteristics of the alloys.

6249 (ORNL—5404) **Creep and creep-rupture behavior of ERNiCr-3 weld metal.** Klueh, R.L.; King, J.F. (Oak Ridge National Lab., TN (USA)). Jun 1978. Contract W-7405-ENG-26. 46p. AT.

Creep and creep-rupture tests were made on AWS A5.14 Class ERNiCr-3 weld metal, commonly known as Inconel 82. Tests

were made over the range 454 to 732°C on specimens taken from welds made by the gas tungsten-arc process. The results fell into two categories: those for tests at 454, 510, and 566°C displayed different characteristics than those at 621, 677, and 732°C. At the lower temperatures the creep curves were characterized by a rapid transient, a long steady-state stage, and little tertiary creep. At the elevated temperatures the transient stage was not as rapid, the steady-state creep stage was shorter, and the tertiary stage was longer. The low-temperature creep-rupture curves and stress-minimum creep rate curves were also much flatter than those at the elevated temperatures. For certain tests at 454, 510, and 566°C the creep curves exhibited an "instantaneous elongation" or "strain burst" phenomenon, in which the creep curves contained strain jumps. At these same temperatures, several specimens failed prematurely. Strain bursts are postulated to be related to the formation of dislocation pileups in the matrix. When a localized pileup breaks through a barrier, a dislocation avalanche results and triggers neighboring pileups continuing into neighboring grains giving rise to the propagation of a deformation band along the gage length in a Luder's-type deformation. It was proposed that the premature failures were related to the strain burst phenomenon and some scattered "voids" or "cracks" that were observed in the as-welded microstructure.

6250 (ORNL/TM—6285) **Influence of small amounts of niobium on mechanical and corrosion properties of type 304 stainless steel.** Sikka, V.K.; Moorhead, A.J.; Brinkman, C.R. (Oak Ridge National Lab., TN (USA)). Jun 1978. Contract W-7405-ENG-26. 77p. AT.

Creep and creep-rupture properties of several experimental heats of type 304 stainless steel containing 20, 50, 100, 200, 500, 700, and 1000 ppM (by weight) Nb were investigated in the temperature range 482 to 649°C. Resistance to intergranular corrosion of these heats was also studied. Results of the tests on the experimental heats were compared with the creep properties of 20 commercial heats of type 304 stainless steel and data from the literature on several heats of type 347 (4000 to 8000 ppM Nb) stainless steel. Results on experimental heats were used to check that heat-to-heat variations in creep properties of 20 commercial heats of type 304 stainless steel are caused by variations in carbon, nitrogen, grain size, and for the most part by residual niobium (10 to 200 ppM). The time to rupture increased and minimum creep rate decreased with increasing niobium content until a saturation level was attained at about 500 to 1000 ppM. Type 304 stainless steel containing 500 ppM Nb offers superior creep and creep-rupture properties with improved creep ductility and a factor of approximately 5 better intergranular corrosion resistance (in boiling $CuSO_4$ solution) than type 304 stainless steel (20 ppM Nb). Type 304 containing 500 to 1000 ppM Nb exhibits a weldability similar to that of type 304 stainless steel.

6251 (UCRL—50028-78-2) **H-Division quarterly report, April—June 1978.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Aug 1978. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

The Theoretical EOS (equation of state) Group develops theoretical techniques for describing material properties under extreme conditions and constructs EOS tables for specific applications. Work is reported on the following topics: observation and model for dynamic effects in shock data of polymorphic solids; a theory of melting curve extrema; calculation and tabulation of isoelectronic energy levels from He to Ni; EOS of compressed T = 0 copper; pressure ionization in compressed Al and Cs. The Experimental Physics Group investigates the properties of materials at extreme conditions of pressure and temperature, and develops new techniques for these investigations; it also studies the response of materials to a wide range of dynamic pressures and temperatures. Work is reported on the following topics: Hugoniot measurements on liquid Ar; flash x-ray diffraction; preliminary specific heat results for liquid Ir to 5700K. The Fluid Physics Group is concerned with the study of nonequilibrium and rate-dependent constitutive properties such as turbulence, viscosity, electrical and thermal conductivity, and optical properties of fluids; it also carries out computer simulations of fluid flow. Work is reported on the following topics: the viscosity of Li, H, and LiH; turbulence transport in gun barrel propellant erosion; exact free-volume calculation; steady-state dislocation motion; viscous effects on turbulent-jet flow near nozzle exit. The work of the Solid Mechanics Group includes the physics of crack initiation and propagation in ductile steels and fluid—structure interaction in nuclear pressure vessel containment structures. Work is reported on the following topics: target penetration; target surface response to penetration; numerical simulations of the Cabriolet event. 29 figures, 2 tables. (RWR)

6252 (WAPD-TM—1233) **REL02: a Monte Carlo technique to calculate failure probability.** Rauth, D.R.; Smith, C.M. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Aug 1978. Contract EY-76-C-11-0014. 27p. Dep. NTIS, PC A03/MF A01.

The REL02 program uses a simplified Monte Carlo technique to calculate the failure probability of the interaction of two random variates X and Y. Six options are available: Option 1, when X and Y are both normal distributions; Option 2, when X and Y are both truncated normal distributions; Option 3, when X is a normal distribution and Y is a Weibull distribution; Option 4, when X and Y are both Weibull distributions; Option 5, when X is a truncated normal distribution and Y is a Weibull distribution; and Option 6, when X is a truncated normal distribution and Y is a uniform distribution. The average failure probability as well as the density of the failure calculations are available as a listing and graphical plots. 7 figures, 4 tables.

6253 **Use of martensite reversion in the design of tough ferritic cryogenic steels.** Morris, J.W. Jr.; Jin, S.; Syn, C.K. (Univ. of California, Berkeley). pp 393-397 of New aspects of martensitic transformation. Sendai, Japan; Japan Inst. of Metals (1976).

From Proceedings of the first JIM international symposium on new aspects of martensitic transformation; Kobe, Japan (10 May 1976).

The use of a martensite reversion reaction followed by a two-phase decomposition treatment in a cyclic thermal treatment allows the achievement of ultra-fine grain size in steels containing 8-12 percent Ni. The grain refinement leads to a substantial improvement in cryogenic mechanical properties. The ductile-brittle transition temperature of a ferritic Fe-12Ni-0.25Ti alloy was suppressed to below liquid helium temperature by this grain refinement procedure; the transition temperature of commercial "9Ni" cryogenic steel was similarly reduced by combining the grain refinement with a final temper which introduces a small admixture of retained austenite.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 6245, 6251, 6269, 6354, 6995

6254 (BNL—24655) **Ground state properties and energy parameters of the Anderson lattice system, $CeAl_2$.** Parks, R.D.; Kupferberg, L.C.; Croft, M.C.; Shapiro, S.M.; Gurewitz, E. (Rochester Univ., NY (USA); Rutgers--the State Univ., Piscataway, NJ (USA); Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 7p. (CONF-780913—3). Dep. NTIS, MF A01.

From Colloque of physics of the metallic rare earths; St. Pierre De Chartreuse, France (4 Sep 1978).

Portions of document are illegible.

Magnetostriction and thermal expansion measurements on $CeAl_2$ in and near the antiferromagnetic (AF) phase have established the AF phase boundary in the H-T plane; the nature of the reorientation of the AF domains in field, the evolution of the AF order parameter in field and the nature of the AF fluctuations above T/sub N/; and that the magnetic exchange between Ce atoms is ferromagnetic in large fields. Inelastic neutron scattering measurements reveal a new and yet unexplained feature at 17.5 MeV. The compound $CeAl_2$ is an Anderson lattice system in the local moment regime, which appears to display a competition between spin fluctuations and indirect magnetic exchange. In this paper we summarize the results of an extensive study of the macroscopic thermodynamic properties of $CeAl_2$ and present some preliminary results of an ongoing neutron scattering study.

6255 (CONF-780823—5) **Magnetic susceptibility of U/sub 1-x/Th/sub x/Al_2.** Brodsky, M.B. (Argonne National Lab., IL (USA)). 1978. Contract W-7405-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From Conference on the electronic structure of the actinides; Grenoble, France (30 Aug 1978).

Magnetic susceptibility measurements have been made on U/sub 1-x/Th/sub x/Al_2 for x less than or equal to 0.10. All of the samples show a low-temperature T^2 dependence, and an apparent Fermi liquid contribution.

6256 (CONF-780823—6) **Micro-magnetic susceptometer for the actinides.** Nave, S.E.; Huary, P.G. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From Conference on the electronic structure of the actinides; Grenoble, France (30 Aug 1978).

A D.C. magnetic susceptometer incorporating a SQUID as a magnetic flux sensor has been constructed with sensitivity to measure the magnetic susceptibility of submicrogram actinide samples as a function of temperature. For a two microgram actinide sample the minimum measurable dimensionless susceptibility is approximately 10^{-7} CGS in a 2000 gauss field. The sensitivity has been determined in a series of calibration experiments using samples of lead spheres at 4.2°K. Pick-up coils insensitive to changes in spatially uniform fields and fields with a constant first derivative were used to reduce noise. The field was trapped in a niobium cylinder to produce a uniform stable applied field. The flux produced by the sample in the pick-up

coils is proportional to the magnetic susceptivility of the sample and is a function of the sample position.

6257 (COO—4540-1(Vol.2), pp 231-257) **Gas—metal reactions in vanadium and vanadium-base alloys.** Apr 1978.

In Technical assessment of vanadium-base alloys for fusion reactor applications. Volume 2. Review of properties: vanadium and vanadium-base alloys. Final report.

This section deals with the solubility, diffusion, permeation, and reaction of vanadium with the gases oxygen, nitrogen, and hydrogen, and with carbon. The effects of these interstitial impurities on mechanical properties are also described. This section will show the extent of available data which can be used to understand how the impurity was added to or removed from the metal, how fast it moves through the metal, and what factors affect its solubility, diffusivity, and/or permeability.

6258 (COO—4540-1(Vol.2), pp 258-268) **Consolidation and fabrication of vanadium and vanadium-base alloys.** Apr 1978.

In Technical assessment of vanadium-base alloys for fusion reactor applications. Volume 2. Review of properties: vanadium and vanadium-base alloys. Final report.

The following topics are discussed in this section: (1) preparation of V metal, (2) purification, (3) alloy melting, (4) primary working, (5) secondary working, and (6) welding. (MOW)

6259 (IS-M—148) **Low temperature heat capacity studies on intermetallic and semimetallic rare earth compounds.** Gschneidner, K.A. Jr.; Takeshita, T.; Beaudry, B.J.; McMasters, O.D.; Taher, S.M.A.; Ho, J.C.; King, G.B.; Gruber, J.B. (Ames Lab., IA (USA)). 1978. Contract W-7405-ENG-82. 6p. (CONF-780913—1). Dep. NTIS, PC A02/MF A01.

From Colloque of physics of the metallic rare earths; St. Pierre De Chartreuse, France (4 Sep 1978).

The results of low temperature (1 to 20°K) heat capacity measurements on some RM_5 phases, which are good hydrogen absorbers, and on some La_3S_4—La_2S_3 compounds are reported and discussed. Also included are some measurements on the superconducting $LaS_{1.33}$—$LaS_{1.40}$ phases.

6260 (LA-UR—78-1955) **μiSR in imperfect solids.** Huang, C.Y.; Huber, D.L. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 10p. (CONF-780911—1). Dep. NTIS, PC A02/MF A01.

From 1. meeting on muon spin rotation; Rorschach, Switzerland (4 Sep 1978).

The use of μ^+SR as a probe of point defects in metals is discussed. The importance of separating the effects due to the presence of the muon from those intrinsic to the defect-host system is stressed. It is suggested that studies of magnetic impurities in nonmagnetic hosts may yield data which are relatively probe-independent. A theoretical analysis of the depolarization of muons coupled to magnetic impurities is outlined. It is pointed out that measurements of the magnetic field dependence of the depolarization rate can give information about impurity spin correlation time.

6261 (LBL—7639) **Infrared absorption spectroscopy of surfaces: a low temperature thermal detection scheme.** Bailey, R.B.; Richards, P.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1978. Contract W-7405-ENG-48. 18p. (CONF-7806103—1). Dep. NTIS, PC A02/MF A01.

From 38. conference on physical electronics; Gatlinburg, TN, USA (19 Jun 1978).

A sensitive spectroscopic technique has been developed by which infrared surface absorptions are detected thermally in a sample cooled to liquid helium temperature. A tiny doped germanium thermometer attached directly to the sample crystal measures the temperature increase resulting from infrared absorption. The assembly is mounted in an ultrahigh vacuum chamber and can be repeatedly cleaned, heated, exposed to chemical reactants, and cooled to 1.5 K for spectral measurements. Preliminary data for various molecules adsorbed on evaporated metal films demonstrate that the technique is a practical means for obtaining sensitive, high resolution vibrational spectra of adsorbed molecules.

6262 (LBL—7682) **Thermal expansion of the directionally solidified Al—$CuAl_2$ eutectic.** Baker, D.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 97p. Dep. NTIS, PC A05/MF A01.

Thesis.

Alloys of Al-$CuAl_2$ eutectic composition were prepared with high purity materials (99.999%) and directionally solidified horizontally in a rectangular ceramic boat at 0.96, 4.0, 8.3, 17.5, and 82.0 μm/sec through a temperature gradient of 45°C/cm. These ingots were examined macroscopically and the best single grain regions were selected for further measurements. From micrographs taken of the top, side and cross section of the ingot, it was found that the interlamellar spacings were 7.5, 3.5, 2.6, 1.8 and 1.4 μm respectively, and from the measured lamellar orientation relationships specimens were machined with axes aligned in the principal lamellae coordinate directions. Transmission Laue photographs taken using Ni filtered Cu Kα radiation verified that the texture is consistent with the crystallographic relationships (121)/sub theta/ vertical bar vertical bar (111)/sub Al/; <12anti 3>/sub theta/ vertical bar vertical bar <1anti 21>/sub Al/. Thermal expansion was measured by standard dilatometry (Cu standard) using a set point program cycling between room temperature and 500°C. It was found that the thermal expansion of the directionally solidified Al-$CuAl_2$ eutectic decreases with increasing interlamellar spacing, is greatest in the growth direction (approximately <1anti 21>/sub Al/, in the plane of the lamellae) least in the transverse direction (approximately <10anti 1>/sub Al/, in the plane of the lamellae), and intermediate in the second transverse direction (approximately <111>/sub Al/ normal to the lamellae). These results confirm that the $CuAl_2$ phase is anisotropic with respect to thermal expansion, but the interlamellar spacing dependence of thermal expansion is not predicted by any known theory of composite materials.

6263 (MLM—2540(OP)) **Inconel-600/T-111 alloy compatibility studies.** Teaney, P.E. (Mound Facility, Miamisburg, OH (USA)). 1978. Contract EY-76-C-04-0053. 8p. (CONF-780732—1). Dep. NTIS, PC A02/MF A01.

From Metallographic Society Technical conference; Montreal, Canada (16 Jul 1978).

Oxidation resistant Hastelloy-C is the material presently used to clad a small radioisotopic heat source. Inconel-600 has properties and composition similar to Hastelloy-C and is under consideration as an alternate clad material. To serve this purpose, the material must be compatible with the underlying T-111 alloy strength member. Upon completion of compatibility studies, metallographic examination of the specimens revealed reaction zones that appeared to be influenced by time and temperature. The widths of the zones were determined by linear measurements from photomicrographs. These data were used to determine rate curves for the reaction at 1000, 1100, 1225°C. The activation energy for the reaction was determined from these rate curves. The data for Inconel-600, when compared to previously accumulated data for Hastelloy-C, indicated that Inconel-600 can be substituted for Hastelloy-C and will pose no compatibility problem in the heat source.

6264 **Interstitial ordering and precipitation in dilute Ta—O alloys at 100 to 270°C.** Milillo, F.F. (Union Coll., Schenectady, NY); Potter, D.I. *Metall. Trans., A;* 9: 283-290(Feb 1978).

Dilute solid solutions of bulk tantalum containing up to 4 at. pct oxygen were aged at temperatures from 100 to 270°C. The formation of the most dilute suboxide was monitored using transmission-electron microscopy and diffraction, x-ray diffraction, electrical resistivity and microhardness changes. The transformation proceeds in two stages with time exponents of approximately $^3/_2$ and $^1/_2$, and both stages have activation energies equal to oxygen diffusion in α-tantalum. The suboxide has ideal composition $Ta_{12}O$ and closely resembles the analogous phase $V_{12}O$ of the vanadium-oxygen system. $Ta_{12}O$ manifests different morphologies ranging from the tweed microstructure observed at short aging times, to the periodic arrays of cuboids found at intermediate times, to the lamellae and discs observed at long aging times. Crystallographically, $Ta_{12}O$ is described by a long period supercell enclosing 4 X 4 tantalum atom cells in two directions and averaging 3.3 cells in the third dimension. The basic cell describing the supercell is face-centered tetragonal and 4 X 4 X 1 tantalum cells in dimension. The tantalum atoms in the suboxide occupy a body-centered tetragonal lattice with c/a = 0.989. These findings are used to clarify previous electron diffraction data for transformed Ta-O thin films, reinterpret the formation of $Ta_{16}C$, and discuss static concentration wave calculations of interstitial phases.

6265 **Optical properties of small particle composites: theories and applications.** Lamb, W.; Wood, D.M.; Ashcroft, N.W. (Cornell Univ., Ithaca, NY). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 240-255(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

The problem of calculating the optical properties of an assembly of small metallic spheres (radius a) dispersed in a dielectric host is approached from the standpoint of multiple scattering theory as formulated for scalar fields and periodic systems by Morse. If k is the largest wave vector of the radiation in either the bulk constituent or in the composite, the leading term for the dielectric function in the limit ka $\rightarrow$ 0 emerges as the Maxwell-Garnett result. The result is subject to significant modification, however, if structure in the composite large on the scale of a wavelength (e.g. clustering or periodicity in the dilute limit) is present. For both Maxwell-Garnett and effective medium theories the effects of introducing a third component in the form of an insulator coating (spatially correlated, therefore, to the metallic component) are examined, particularly in the frequency dependent reflectivity. Finally, an argument is given

for the two component system which leads to the Maxwell-Garnett result from consideration of an effective medium approach for insulator-coated metallic inclusions, these properly reflecting the topology of such composites. For m(>2) component systems an expression for the effective dielectric function is derived by applying a similar argument.

6266 Hopping conduction and superconductivity in granular aluminum. McLean, W.L.; Lindenfeld, P.; Worthington, T. (Rutgers-the State Univ., New Brunswick, NJ). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 403-407(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

We have measured the electrical resistance as a function of temperature and magnetic field in superconductive granular aluminum specimens with room temperature resistivities up to 0.04 Ω-cm. In the normal state conduction is dominated by thermally activated hopping although the variation of log R with T cannot be described by a simple power law. Superconducting fluctuations persist in fields up to 55 kG even above 2T/sub c/. At higher fields there is a negative quadratic magnetoresistance which we interpret in terms of the Zeeman contribution to the characteristic energy in the expression for the hopping conductivity.

6267 Anomalous electrical resistivity and magnetic susceptibility temperature dependences in Ti—V alloys exhibiting reversible soft-phonon-induced structural inhomogeneities. Collings, E.W. (Battelle Memorial Inst., Columbus, OH). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 410-415(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

Electrical resistivity studies of a series of Ti-V alloys have revealed anomalously large isothermal resistivities within the composition range 10 to 70 at.%V, and a negative resistivity temperature dependence within 20 to 33 at.%V. Alloys such as Ti-V exhibit electronically induced lattice instability which increases in severity as the electron/atom ratio decreases, and which manifests itself as a 2/3 (111) longitudinal lattice displacement wave, the source of the ω-phase precipitation. Whether the negative resistivity temperature dependence was a result of scattering by phonons or by phonon-induced reversible athermal precipitation was not obvious. Analysis of the results of magnetic susceptibility temperature dependence measurements on the same system, however, yielded a reversible component whose appearance and disappearance paralleled the resistivity result. It follows that the anomalous resistivity is, at least in part, of macroscopic origin.

6268 Vapor pressure of liquid cesium by a Knudsen-effusion radiotracer technique. Behrens, R.G.; Woodrow, H.O.; Aronson, S. (Los Alamos Scientific Lab., NM). *J. Chem. Thermodyn.;* **9**: 1035-1044(1977).

The vapor pressure of liquid cesium has been measured over the temperature range 327 to 459°K using a Knudsen-effusion radiotracer technique. The vapor pressure over this temperature range is (R/cal/sub th/ $K^{-1}mol^{-1}$)ln(p/atm) = -(16493 +- 522) (K/T) + (16.02 +- 1.38). The third-law enthalpy for the reaction Cs(c) = Cs(g) obtained from the present results is $\Delta H°(298.15\ K)$ = (18.44 +- 0.36) kcal/sub th/mol^{-1}. The second-law result is $\Delta H°(298.15\ K)$ = (17.31 +- 0.52) kcal/sub th/mol^{-1}. Standard thermodynamic functions for Cs_2<g) are computed using a spectroscopically derived Cs—Cs bond distance. The entropy of Cs_2(g) is computed to be $S°(298.15\ K)$ = 68.053 cal/sub th/ K^{-1} mol^{-1}, 0.2 cal/sub th/ K^{-1} mol^{-1} higher than the previously reported value. Literature vapor pressures above 500 K are re-evaluated and compared with the present and literature low-temperature vapor pressures. On the basis of this evaluation, the vaporization enthalpy is chosen to be $\Delta H°(H98.15\ K)$ = (18.33 +- 0.36) kcal/sub th/ mol^{-1}.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 5204, 5209, 5392, 5393, 5394, 5395, 5396, 5618, 5805, 6187, 6250, 6362

6269 (COO—2128-13) **Positron lifetime measurements as a non-destructive technique to monitor fatigue damage. Final report, January 1, 1971—June 30, 1978.** Byrne, J.G. (Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering). Jun 1978. Contract EY-76-S-02-2128. 14p. Dep. NTIS, PC A02/MF A01.

Positron studies were applied successfully to cyclic fatigue in steel and copper and have shown a capability to nondestructively detect fatigue softening and fatigue hardening. In the case of elastic high cycle fatigue in initially soft steel the fatigue hardening is identified with point defects. For cyclic plastic range, high cycle fatigue cyclic hardening and softening are correlated with changes in dislocation substructure. Positron measurements during the pulse annealing of copper single crystals following electron irradiation at 77°K have revealed the formation of multi-vacancy complexes which constitute the precursors of radiation induced voids. Positron studies have been applied to hydrogen embrittlement in 4340 steel and more recently in nickel. The technique can non-destructively detect hydrogen embrittlement and gage its extent. U.S. Patent No. 4064438 was issued on this basis.

6270 (COO—4540-1(Vol.2), pp 195-230) **Corrosion and compatibility in liquid alkali metals.** Apr 1978.

In Technical assessment of vanadium-base alloys for fusion reactor applications. Volume 2. Review of properties: vanadium and vanadium-base alloys. Final report.

The literature dealing with liquid alkali metal corrosion of vanadium and its alloys is reviewed in the following subsections. Attention is given to both lithium and sodium data. Preceding this review, a brief outline of the current state of understanding of liquid metal corrosion mechanisms is provided.

6271 (LA—7434-P) **Characterization of the Delhi Pillar.** Fullbright, H.J.; Schwalbe, L.A.; Ellis, W.P. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

A detailed study of the internal and surface properties of the Delhi Pillar is proposed. These studies will be done on the site in collaboration with Indian scientists and engineers. All results obtained from this work either will be published in the open literature or will be otherwise made available to the general scientific community.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 5758, 5761, 5769, 5893, 7114, 7132

6272 (CONF-780722—2) **Reduction of irradiation-induced creep by point defect trapping.** Mansur, L.K.; Wolfer, W.G. (Oak Ridge National Lab., TN (USA); Wisconsin Univ., Madison (USA)). [nd]. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A03/MF A01.

From 9. symposium on effects of radiation in structural materials; Richland, WA, USA (10 Jul 1978).

The theory of point defect trapping was applied to predict the effect of solutes on the steady-state dislocation climb creep rate. Vacancy loops generated in the cascades of point defect production by heavy particles were included. It is shown that the effect of vacancy loops on the creep rate is mathematically equivalent to a simultaneous reduction in the vacancy trapping rate at solutes as well as in the free point defect generation rate and recombination coefficient. These parameters are reduced by the ratio of the sink strength without vacancy loops to the total sink strength. Solute trapping and vacancy loops do not reduce the unperturbed creep rates by more than an order of magnitude for the parametric range considered.

6273 (CONF-780722—8) **Estimates of time-dependence fatigue behavior of type 316 stainless steel subject to irradiation damage in fast breeder and fusion power reactor systems.** Brinkman, C.R.; Liu, K.C.; Grossbeck, M.L. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

From 9. symposium on effects of radiation in structural materials; Richland, WA, USA (10 Jul 1978).

Cyclic lives obtained from strain controlled fatigue tests at 593°C from specimens irradiated to a fluence of 1 to 2.63 x 10^{26} n/m^2 (E greater than 0.1 MeV) were compared to predictions based on the method of strainrange partitioning. When appropriate tensile and creep-rupture ductilities were employed reasonably good estimates of the influence of hold periods and irradiation damage on the fully reversed fatigue life of type 316 stainless steel could be made. Ductility values for 20 percent cold-worked type 316 stainless steel specimens irradiated in a mixed spectrum fission reactor were used to estimate fusion reactor first wall lifetime. The ductility values were from irradiations that simulate the environment of the first wall of a fusion reactor. Neutron wall loadings ranging from 2 to 5 MW/m^2 were used. Results, although conjectural because of the many assumptions, tended to show that 20 percent cold-worked type 316 stainless steel could be used as a first wall material meeting a 7.5 to 8.5 MW-year/m^2 lifetime goal provided the neutron wall loading does not exceed more than about 2 MW/m^2. Results were obtained for an air environment, and it is expected that the actual vacuum environment will extend lifetime beyond 10 MW-year/m^2.

6274 (COO—4540-1(Vol.2), pp 1-57) **Radiation effects in vanadium and vanadium-base alloys.** Apr 1978.

In Technical assessment of vanadium-base alloys for fusion reactor applications. Volume 2. Review of properties: vanadium and vanadium-base alloys. Final report.

Data are reviewed for each of the following areas: (1) radiation anneal hardening in vanadium, (2) void swelling and precipitation in neutron irradiated V and V-base alloys, (3) mechanical properties of neutron irradiated or helium injected V-base alloys, and (4) ion irradiated simulation studies in V and V-base alloys. (MOW)

6275 (HEDL-SA—1462) **Tensile property correlations for highly irradiated 20% C.W. type 316 stainless steel.** Fish, R.L.; Cannon, N.S.; Wire, G.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 11 May 1978. Contract EY-76-C-14-2170. 26p. (CONF-780722—3). Dep. NTIS, PC A03/MF A01.

From 9. symposium on effects of radiation in structural materials; Richland, WA, USA (10 Jul 1978).

Experiments on developmental FFTF cladding (20% C.W. Type 316 stainless steel) extended the data base to a fast neutron fluence of 8.4 x 10^{22} n/cm² (E > 0.1 MeV). The specimens were irradiated at temperatures ranging from 371° to 816°C, although peak fluence levels were attained on specimens irradiated near 371°C and 649°C. Tension tests were performed at 232°C, near the irradiation temperature, and in some cases, above the irradiation temperature. Test specimen strain rates ranged from 4 x 10^{-5}/s to 4 x 10^{-3}/s. Data generated on cladding irradiated near 371°C established that the low temperature strength and ductility are fluence independent beyond about 5 x 10^{22} n/cm² (E > 0.1 MeV). Strength behavior of the irradiated cladding at 538°, 593°, and 649°C is essentially the same as exhibited by thermally aged developmental cladding at the same temperatures and times. Up to a fluence of approximately 5 x 10^{22} n/cm² (E > 0.1 MeV), the 538°C ductility values remain relatively fluence independent after an initial decrease. Higher temperature (593°C and 649°C) ductilities decrease continually with increasing fluence. Tensile parameter correlations were developed for the prediction of irradiation effects on the tensile properties of 20% C.W. Type 316 stainless steel. These correlations are based on unirradiated tensile property correlations developed using Hart's equation of state. The condition of plastic deformation of materials such as 316 stainless steel, can be characterized by a structure parameter (sigma*) which describes the material's "hardness." Irradiation effects can be incorporated into this formulation by parameterizing the changes in sigma* with irradiation temperature and fluence. Correlations provide a description of strength and ductility over the temperature range of 371°C to 871°C and strain rates of 10^{-5} to 10^{1}/s.

6276 (SAND—78-0914C) **Microstructure of Fe implanted with Ti.** Follstaedt, D.M.; Myers, S.M. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 8p. (CONF-780932—1). Dep. NTIS, PC A02/MF A01.

From Conference on ion beam modification of materials; Budapest, Hungary (4 Sep 1978).

Microstructural studies of α-Fe (approximately 0.01 at. % C) implanted with titanium and subsequently annealed are reported. Ion beam analysis and transmission electron microscopy (TEM) are used to identify the precipitated phases and to obtain their microstructure. This investigation provides a basis for interpreting studies of Sb trapping at Ti-rich regions in Fe. Moreover, it has broader relevance to the behavior of strong carbide formers implanted into bcc steels. The results suggest a method to achieve surface hardening, as will be discussed.

6277 (SAND—78-1199C) **Annealing behavior and selected applications of ion-implanted alloys.** Myers, S.M. (Sandia Labs., Albuquerque, NM (USA)). [nd]. Contract EY-76-C-04-0789. 28p. (CONF-780675—1). Dep. NTIS, PC A03/MF A01.

From Symposium on ion implantation--new prospects for materials modification; Yorktown Heights, NY, USA (14 Jun 1978).

Thermally activated processes cause ion-implanted metals to evolve from the initial state toward thermodynamic equilibrium. The degree of equilibration is strongly dependent upon temperature and is considered for three temperature regimes which are distinguished by the varying mobilities of interstitial and substitutional atoms. In addition, perturbations resulting from the irradiation environment are discussed. Examples are given of the use of implanted and annealed alloys in studies of diffusion, phase diagrams, and solute trapping.

6278 (UWFDM—252) **Effects of bombarding ions on the void swelling profile in nickel.** Whitley, J.B.; Kulcinski, G.L.; Smith, H.V. Jr.; Wilkes, P. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Jul 1978. Contract ET-78-S-02-4636. 25p. (CONF-780722—11). Dep. NTIS, PC A02/MF A01.

From 9. symposium on effects of radiation in structural materials; Richland, WA, USA (10 Jul 1978).

Specimens of high purity nickel were irradiated with high energy carbon and aluminum ions to study the effect on the void microstructure of using different bombarding species. The depth dependent damage structure was determined by preparing the foils such that they could be viewed directly in cross section. These results were then compared to previous irradiations performed on identical material using self-ions. The swelling behavior observed in the end-of-range region for all samples was similar, implying that impurities introduced by the ion beam do not strongly influence the swelling response of the material. The mass of the irradiating ions had no noticeable effect on the swelling values achieved for similar damage states, even though the recoil energy spectrum produced by the various ions were different. A dose scan using aluminum ions showed the void density to rise very rapidly and then drop with increasing dose above 2 dpa. Voids were also observed in all specimens at depths approximately equal to 15% beyond the predicted end-of-range.

6279 **Modification of the existing yielding creep theory of irradiation creep in zirconium and Zircaloy-2.** Madden, P.K.; Hesketh, R.V. (Central Electricity Generating Board, Berkeley, Eng.). *Nucl. Technol.;* **33**: No. 1, 96-102(Apr 1977).

The theory of yielding creep is modified to include a time dependence of irradiation growth. The predicted time dependence of irradiation creep is compared with the values measured in zirconium alloys. Good agreement is found for unhydrided Zircaloy. In hydrided Zircaloy it is assumed that the (unmeasured) irradiation growth rate increases with increasing hydrogen concentration.

CERAMICS, CERMETS, AND REFRACTORIES

6280 (WAPD-TM—1340) **Properties of thoria and thoria-urania: a review (LWBR Development Program).** Belle, J.; Berman, R.M. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jun 1978. Contract EY-76-C-11-0014. 133p. Dep. NTIS, PC A07/MF A01.

Information on the physical, chemical, and mechanical properties of thoria and thoria-urania is reviewed and assessed. The properties discussed are those judged to be important for an understanding of the behavior of these oxides as nuclear fuel materials. Evaluation was made, where possible, of the effects of composition, material variables, temperature, and irradiation exposure. Data were taken from a review of the literature and from both published and unpublished data derived from the Light Water Breeder Reactor (LWBR) Program at the Bettis Atomic Power Laboratory. 30 figs., 23 tables, 163 refs.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 5294, 6119, 6236, 6284, 6378

6281 (LBL—8023) **Electrochemical machining of carbides and borides.** Dissaux, B.A.; Muller, R.H.; Tobias, C.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1978. Contract W-7405-ENG-48. 127p. Dep. NTIS, PC A07/MF A01.

Thesis. Submitted by B. A. Dissaux.

The use of high rate anodic dissolution (electrochemical machining) for shaping titanium carbide, zirconium carbide, titanium boride and zirconium boride has been investigated in 2N potassium nitrate and 3N sodium chloride under current densities ranging from 20 to 120 A/cm² (corresponding to cutting rates of 0.3 to 1.8 mm/min). The dissolution stoichiometry for all these materials is independent of the current density in the range 20 to 120 A/cm². Both titanium and zirconium appear to dissolve in the +4 state, boron in the +3 state and the weight loss measurements indicate that carbon is oxidized to CO and CO_2. The current voltage curves permit to establish that, over the entire current density and flow range investigated, dissolution occurs in the transpassive state. The surface roughness obtained on TiC and ZrC is within 3 to 5 μm and is independent of current density, applied voltage or flow rate.

6282 (UCID—17805) **Pressure bonding molybdenum alloy (TZM) to reaction-bonded silicon nitride.** Huffsmith, S.A.; Landingham, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1978. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

Topping cycles could boost the energy efficiencies of a variety of systems by using what is now waste heat. One such topping cycle uses a ceramic helical expander and would require that a reaction-bonded silicon nitride (RBSN) rotor be bonded to a shaft of TZM (Mo-0.5 wt % Ti-0.08 wt % Zr). Coupon studies show that TZM can be bonded to RBSN at 1300°C and 69 MPa if there is an interlayer of $MoSi_2$. A layer of finely ground (10 μm) $MoSi_2$ facilitates bond formation and provides a thicker bond interface. The hardness and grain structure of the TZM and RBSN were not affected by the temperature and pressure required to bond the coupons.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 6118, 6121, 6236, 6285, 6378, 6993

6283 (UCRL—52518) **Isotherms for the U—UH_3—H_2 system at temperatures of 700 to 1065°C and pressures to 137.9 MPa.** Lakner, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jun 1978. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

A new pressure system utilizing a heated internal pressure vessel was used to obtain pressure-vs-composition isotherms for the U—H system over the range 700—1065°C at pressures up to 137.9 MP (1361 atm). The experimentally determined "plateau" pressures are compared with values extrapolated from lower temperatures and pressures previously obtained by other workers. The current investigation shows that, in contrast to the work of Chevalier, et al., the U—H system retains broad two-phase plateaus at temperatures as high as 1065°C. 19 figs, 3 tables.

6284 Conductivity of thick film (Cermet) resistors as a function of metallic particle volume fraction. Pike, G.E. (Sandia Labs., Albuquerque, NM). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 366-371(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

Thick film resistors (TkFR) are composites of metallic particles embedded in a glass matrix. Conduction is through interconnected particle chains. For each of five systems studied the conductivity varies over many decades with particle volume fraction v/sub m/. It follows a power law dependence, G = K(v/sub m/ - v/sub m,c/)/sup t/, where K, v/sub m,c/ and t are constants for a given system. There are two interesting features of this relation for TkFRs: v/sub m,c/ is very low (0.02 or less) and t is rather high ($3 < t < 7$). These values of v/sub m,c/ and t differ considerably from those of percolative systems in which v/sub m,c/ is much higher and the critical exponent t approximately 1.6. Nevertheless, a model is proposed for which the conductance is indeed governed by percolation. This model takes explicit account of the resistor formation process and the observed microstructure. It is essentially a modified bond percolation model in which the metallic particles are partial bonds in the lattice connecting the interstices of the relatively larger, close-packed glass particles.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 4984

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 5295, 5297, 5757, 6118, 6119, 6120, 6121, 6264, 6281, 7126

6285 (LBL—8004) **Poling effect on piezoelectric behavior of PZT ceramics.** Chiang, S.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 74p. Dep. NTIS, PC A04/MF A01.

Thesis.

Rod-shaped PZT specimens were sintered with 1 w/o and 5 w/o PbO additives. ZrO_2 segregations were found in the 1% PbO specimen, and higher PbO segregations were found along the grain boundaries and at grain boundary with no ZrO_2 segregations in the 5% PbO specimen. On the basis of these microstructural observations and preliminary poling studies sintered thin disc specimens with a 3 w/o PbO additive were prepared for extensive poling studies. It was found that the breakdown limit of a specimen depends strongly on the porosity and the pore distribution. The best specimen (3 w/o PbO) could be poled at a field of 6 kV/mm, a temperature of 100°C and a time of 10 minutes without breakdown. The planar coupling coefficient, K/sub p/, under these conditions was immediately after poling equal to 0.62. This value is the highest among the reported K/sub p/ values for pure PZT. Within the breakdown limit, K/sub p/ increases with increase of poling field, temperature and time in a regular manner so that K/sub p/ values for other conditions can be predicted. It was found that the specimen became unstable above 125°C even when poled at low fields for short times. It was also found that a high saturated K/sub p/ value could not be reached at temperatures below 50°C even when poled for long times.

6286 Low-field and high-field hopping conduction in granular metal films. Sheng, P. (RCA Labs., Princeton, NJ). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 143-152(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

Based on the assumption of composition homogeneity, a physical picture of hopping conduction in granular metals is developed which gives temperature and electric field dependences of the conductivity in excellent agreement with experiment. The same hopping conduction picture, when coupled with the assumption about spin-dependent tunneling, is found to explain the striking temperature variation of magnetoresistance in granular Ni—SiO_2. Two material characterization parameters, C and E_0, are identified which respectively define the temperature and the electric field scales of granular metal systems. The relationship between C and E_0, and the composition dependence of C are discussed.

6287 Thermoreflectance of palladium hydride. Frazier, G.A.; Glosser, R. (Univ. of Texas, Dallas). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 342-347(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

Modulated reflectivity data representing the bulk properties of a transition metal-hydride system are presented. The thermoreflectance spectrum of sub-stoichiometric palladium hydride has been measured in the region from 1 to 5 eV using 1000 A films of e-gun evaporated palladium to which hydrogen is added in situ. The hydrogen content is correlated with resistivity measurements. Two structures not seen in the pure Pd spectrum appear at 1.4 and 1.6 eV. The observations were made over the range of 0°C to 60°C with an ambient hydrogen pressure of 35 torr. The amplitude of the 1.6 eV structure passes through a sharp maximum at 27°C and shifts monotonically to the red with increasing temperature at a rate $dE/dT = -3 \times 10^{-3}$ eV/°C. The 1.4 eV feature simply increases in amplitude with no significant frequency shift. These results are compared with existing models for the electronic structure of palladium hydride.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 6119, 6120, 6281

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 5806, 5863, 7122, 7123, 7124, 7125

POLYMERS AND PLASTICS

MECHANICAL PROPERTIES

6288 (BDX—613-1853(Rev.)) **Chemical, thermal, and dynamic mechanical properties of five adhesives.** Baker, G.K. (Bendix Corp., Kansas City, MO (USA)). Aug 1978. Contract EY-76-C-04-0613. 52p. Dep. NTIS, PC A04/MF A01.

The chemical, thermal, and dynamic mechanical properties of five adhesives have been determined. The analyses performed include the determination of the amount and identity of the unbound chemicals extracted from the cured adhesives, the swell ratio, the amount of residual amino, isocyanate, and epoxy groups, dynamic thermogravimetric analysis, isothermal gravimetric analysis, thermal mechanical analysis, storage shear modulus, loss shear modulus, and loss tangent. Two adhesives, Halthane 73-18 and Halthane 87-1, exhibit the best overall properties. They have a high degree of cure, good thermal stability, and elastomeric behavior in the general temperature range required.

6289 (MHSMP—76-30A(Rev.2)) **Physical properties of Halthane series adhesives, Part 1. [Period covered]: April—June 1976.** Lichte, H.W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). 1976. Contract EY-76-C-04-0487. 6p. Dep. NTIS, PC A02/MF A01.

The Halthane series of urethane adhesives synthesized by Lawrence Livermore Laboratory are being studied for application to Pantex assembly processes. The series consists of three each two-part systems designated 73-14, 73-18, and 87-1. The 73-18 system to be used was chosen as the first of the three for physical property testing. Each system has certain advantages, and is designed for a specific application. Systems 73-14 and 73-18 have a lower viscosity than 87-1. System 73-18 has a lower tensile and compressive modulus than 73-14 and 87-1. The increasing order of pot life would rank 73-18, 87-1, and 73-14. All three systems reach two-third hardness in 16 hours.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 6288

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 5481, 5482, 5483, 5485, 5845

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 6318, 6993

6290 (COO—1198-1217(Vol.1)) **Thin-source concentration dependent diffusion.** Eng, G. (Illinois Univ., Urbana (USA). Graduate Coll.). 1978. Contract EY-76-C-02-1198. 179p. Dep. NTIS, PC A09/MF A01.

Thesis.

The diffusion of (Ca^{++}) in NaCl has been measured for various diffusion times and for the temperature range (575° to 775°C), using a thin-source of ^{45}Ca tracer, rectangular geometry, and serial sectioning. The pre-diffusion surface concentration was approximately 3 x 10^{16} (Ca)-atoms/cm^2, which, for an average penetration depth of 100 to 300 μm, produces a maximum (post-diffusion) impurity concentration comparable to or greater than the intrinsic cation vacancy concentration. The high-temperature function closely matches the $D_0(T)$ function obtained from low impurity concentration experiments. The lower-temperature function, combined with the sudden failure of the $D(C) = D_0(1 + [C] + 0.5[C]^2)$ function at these lower temperatures, indicates the onset of a second diffusion process, one which would operate only at extremely high impurity concentrations. This low-temperature behavior is shown to be consistent with a breakdown of the conditions assumed for vacancy equilibrium.

6291 (COO—1217(Vol.2)) **Thin-source concentration dependent diffusion.** Eng, G. (Illinois Univ., Urbana (USA). Graduate Coll.). 1978. Contract EY-76-C-02-1198. 201p. Dep. NTIS, PC A10/MF A01.

Thesis.

The occurrence of non-gaussian ("curved" on [lnC vs. x^2]-axes) penetration profiles as found in heterovalent metal ion diffusion in strongly ionic crystals is investigated. Diffusion of calcium ions in sodium chloride crystals was used experimentally, and a mathematical model was developed around the experiments. (GHT)

6292 (LBL—8041) **Quantum mechanical approach to the velocity of dislocations in ice.** Forouhi, A.R.; Bloomer, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1978. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

A quantum mechanical formulation is used to calculate the velocity of a kink on an otherwise straight dislocation line in ice. Treating the kink as a quasi-particle there exists the probability that it can tunnel through the potential barrier caused by unfavorable positions of the protons on the site just ahead of it. By unfavorable it is meant that the protons are arranged such that point defects occur if the kink proceeds. When an external stress is applied to the system there will be a net drift of the kink which advances the dislocation. The drift velocity thus calculated is in agreement with experimental evidence.

PROPERTIES

REFER ALSO TO CITATION(S) 5491, 5625, 5626, 5780, 5786, 5857, 5861, 5922, 5953

6293 **Optical and infrared reflectance of metal-insulator composites.** Russell, N.E.; Yam, E.M.; Tanner, D.B. (Ohio State Univ., Columbus). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 258-262(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

The reflectance in the infrared and visible (0.08 to 3.2 eV) has been measured for aluminum small particles compacted into potassium chloride. The aluminum particles were prepared by evaporation in inert gas atmosphere and had mean diameters of 200 A and 600 A. The volume fraction, f, of metal in the samples studied was between f = 0.03 and f approximately 1. For f approximately 0.15 the specimens exhibited finite dc conductivity. The main feature of the data is a decreasing reflectance with increasing frequency. The magnitude of the reflectance increases with metal concentration. Comparison of experiment with simple theories shows that the self consistent theory predicts the general form of the reflectance if the low concentration for first achieving conduction is taken into consideration. Kramers-Kronig inversion of the reflectances yields frequency dependent conductivities which are not like those of a simple metal.

6294 **Far infrared absorption in metal-insulator composites.** Russell, N.E.; Carr, G.L.; Tanner, D.B. (Ohio State Univ., Columbus). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 263-268(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

The absorption coefficient of composite systems, formed by compacting together small metal particles and finely ground KCl powder, has been measured at far infrared frequencies (4 to 400 cm^{-1}). The measurements were made on particles of aluminum, prepared by inert gas evaporation, having mean diameters in the range 200 A to 1000 A and on particles of palladium, with mean diameter 2 μm. Measurements were made for metal filling factors, f, between 0.001 and 0.10. The absorption coefficient is nearly linear in concentration for small concentrations but rises more rapidly than linearly at larger values of f, indicating the onset of a metal-insulator transition. The dependence of the absorption coefficient on particle size is very weak. A theory which includes eddy current (magnetic dipole) absorption gives a fair description of the data for the largest particles but falls several orders of magnitude below the data for the smallest ones.

6295 **Optical properties of small-particle composites.** Fuchs, R. (Ames Lab., IA). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 276-282(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

A new theory for the effective dielectric constant of a small-particle composite system includes broadening of single-particle resonances by dipolar interactions and percolation at high particle density. Comparisons are made with effective medium theory, Maxwell-Garnett theory, resistor network models, and with optical measurements on metallic and dielectric composites.

6296 **Near infrared reflectivity at high temperature of layers of silicon containing oxygen.** Sari, S.O.; Masterson, K.D.; Gurev, H.S. (Univ. of Arizona, Tucson). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 311-316(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

Optical reflectivity measurements in the wavelength range of 1 μm to 15 μm are discussed for layers of silane-vapor-deposited silicon on metallic silver. These spectra are dominated by absorption due to both high oxygen concentration in silicon and enhanced intrinsic absorption at the fundamental energy threshold. Some evidence for residual absorption due to localized states below this energy gap also seems to be implied experimentally. Temperature-dependent reflectivity measurements between room temperature and 980°K have been obtained. Interpretation is given of small observed lineshifts, reversible shifts of the silicon edge, and increased film absorption as a function of temperature. X-ray diffraction measurements related to these optical experiments are compared to existing results for sputtered silicon.

6297 **Activation studies in graphite oxidation.** Doak, R.B.; Baron, J.R. (Massachusetts Inst. of Tech., Cambridge). *Prog. Astronaut. Aeronaut.;* **51**: 621-634(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

Surface adjustment times have been obtained for the characteristic hysteresis in reaction probability observed during graphite oxidation in the 900 to 1700°K range. Transient reaction rates were examined after sudden alternation from steady-state 1700°K conditions to 1400°K. Subsequent CO reaction probability changes monitored during exposure to molecular O_2 beams of intensities from 7.1 x 10^{14} - 2.7 x 10^{15} molecules/cm^2-sec indicated characteristic activation times of 0($10-10^2$) hr. An incident O_2 beam proves necessary for surface activation, and the relaxation process correlates with the cumulative number of oxygen molecules to the surface. The fully activated (steady-state) surface required approximately 2 x 10^{20} impinged particles/cm^2, corresponding to removal of about 7 x 10^{17} carbon atoms/cm^2. Widely different transient characteristic times are implied by a two-site mechanism and existing rate constant suggestions. Comparison with measured times suggests their utility in the selection of rate constants for reaction probability temperature dependence.

6298 **Electronic structure of Mott insulators.** Brandow, B.H. (Los Alamos Scientific Lab., NM). *Adv. Phys.;* **26**: No. 5, 651-808(1977).

Mott insulators are identified here with ordinary magnetic insulators. The insulating gap, local moment, and effective spin hamiltonian aspects are qualitatively explained by means of a novel set of solutions of the Hartree-Fock equations. The apparent conflict between Bloch's theorem and localized-electron phenomenology is thereby resolved in an elementary manner. This Hartree-Fock approach also sheds considerable light on the physical mechanisms responsible for the associated metal-insulator (Mott) and other related phase transitions, as observed in V_2O_3 and several other materials. With some generalizations and refinements, this theoretical picture is shown to also account semiquantitatively for a number of detailed properties of NiO and CoO, two of the most extensively studied Mott insulator materials. A wide variety of experimental data for NiO is surveyed in order to determine reasonable values for its effective Hubbard hamiltonian parameters, suitably generalized for the 3d electrons. The problems of formally deriving effective spin hamiltonians for macroscopic magnetic insulator systems are also carefully examined. The old nonorthogonality catastrophe is fully resolved by means of a degenerate (open-shell) analogue of the linked cluster perturbation expansion of Brueckner and Goldstone. Although many quantitative issues remain, these results indicate that there is now a reasonably adequate conceptual understanding of the Mott insulating state.

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 5781, 6259

6299 (RFP—2766) **Studies on prolonging HEPA filter service in chemical applications.** Woodard, R.W.; Terada, K.; Buttedahl, O.I. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1978. Contract EY-76-C-04-3533. 20p. (CONF-780819—3). Dep. NTIS, MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

Portions of document are illegible.

Activities directed toward gaining a better understanding of the performance of materials used in the construction of HEPA filters are described. The report discusses experiments in which materials were exposed to nitric and hydrofluoric acid vapors under controlled conditions in a specially constructed test chamber. In addition, observations are presented on filters tested in actual service. Finally work on cleanable prefilters is reviewed.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 6874

CHEMISTRY

6300 (ORNL—5383, pp 39-45) **Chemical engineering research.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

Mass transfer coefficients were measured for three-phase fluidized beds. Separations of Ni, Cu, and Co were carried out on a continuous chromatograph. Resource recovery from fly ash using the continuous chromatograph was studied. Performance testing of a 10-mm hydroclone was continued using slurries. Experimental and calculated Sherwood numbers are compared for water-mercury in nondispersing two-phase contactors. Agglomeration by asphaltenes in coal liquids was studied. Deep-bed filtration removed colloidal $Fe(OH)_3$ from a test bed. Flooding data were compared in Goodloe-packed columns. (DLC)

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 4986, 4992, 5090, 5217, 6521, 6626

6301 (NUREG/CR—0061) **Preparation of working calibration and test materials: plutonium oxide.** Rein, J.E.; Tietjen, G.L.; Zeigler, R.K.; Waterbury, G.R.; Swanson, G.C. (Los Alamos Scientific Lab., NM (USA)). Apr 1978. Contract W-7405-ENG-36. 46p. Dep. NTIS, PC A03/MF A01.

Procedures are presented for preparing plutonium oxide with assigned values of plutonium content and isotopic distribution. This material is used to calibrate and maintain quality control surveillance of chemical methods for the analysis of nuclear, fuel-cycle plutonium oxide. Detailed statistical treatments are included that give a reliability measure of the prepared material for application to nuclear material accountability and safeguards.

6302 (UCID—15644-77-4) **General Chemistry Division quarterly report, September—December 1977.** Harrar, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Apr 1978. Contract W-7405-ENG-48. 125p. Dep. NTIS, PC A06/MF A01.

Reported are: analytical R and D for the nuclear explosives program, analytical R and D for the energy programs, and special projects. (DLC)

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 6499, 6636

6303 (IS-T—817) **Simultaneous determination of minor and trace elements in coal using instrumental neutron activation analysis.** Clark, L. Jr. (Ames Lab., IA (USA)). Aug 1978. Contract W-7405-ENG-82. 49p. Dep. NTIS, PC A03/MF A01.

Thesis.

The INAA procedure developed in this work is a rapid, accurate, and precise method for determining minor and trace elements (Al, Br, Ca, Cl, Mg, Mn, Ti, V) in coal. This procedure allows the determination of elements with half-lives <10 min which is not usually accomplished by other INAA techniques. The results obtained for the NBS coal are in good agreement with the literature values. The accuracy and the precision is very good. However, the precision of the determinations of the iowa coals was poor. This precision can probably be improved by using better collection, mixing, and drying techniques for the sample. The cleaning procedure used by the ISU Coal Refining Plant appears to remove trace and minor elements as well as sulfur and iron from coal. However, the amount of the element removed seems to depend on the coal in which it is contained. This may be due to the way the element is chemically bound in the coal. However, before any conclusions are drawn, additional analyses should be made on samples taken from the coal and dried with greater care.

6304 **Application of nuclear reactions for quantitative hydrogen analysis in a variety of different materials problems.** Clark, G.J. (Oak Ridge National Lab., TN); White, C.W.; Allred, D.D.; Appleton, B.R.; Koch, F.B.; Magee, C.W. *Nucl. Instrum. Methods;* **149**: 9-18(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

The application of nuclear reaction techniques to hydrogen analysis problems in metallurgical, mineralogical and semiconductor areas is described. Hydrogen analyses and profiles obtained with both the $^1H(^{19}F, \alpha\gamma)^{16}O$ and $^1H(^{15}N, \alpha\gamma)^{12}C$ reactions are presented. The advantages and disadvantages of the two techniques are discussed. Particular emphasis will be given to interpretive problems associated with analyzing the data. Various corrections to the data will be discussed, including off-resonance cross-section corrections and lower energy resonance corrections. Both crystalline and amorphous materials are examined. The hydrogen content of electrodeposited hard gold films has been determined as a function of plating conditions. Hydrogen contents as high as 9 at. % have been measured. The hydrogen profile of natural and synthetic SiO_2 samples was determined. Hydrogen was found to be quite stable in amorphous silica samples but highly mobile in crystalline quartz samples under the analysis conditions. A hydrogen depth profile for a film of glow discharge deposited amorphous silicon (approximately 4500 A thick) has been obtained. 7 figures.

6305 **$H(t,n)^3He$ reaction for depth profiling of hydrogen by neutron time-of-flight.** Davis, J.C. (Univ. of California, Livermore); Lefevre, H.W.; Poppe, C.H.; Drake, D.M.; Veeser, L.R. *Nucl. Instrum. Methods;* **149**: 41-45(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

The usefulness of the H(t,n) reaction for depth profiling of hydrogen in solids was investigated using the pulsed T^+ beam from the Los Alamos vertical Van de Graaff accelerator. A 2.54 cm diameter by 2.54 cm thick stilbene neutron detector was placed at 0^0, 5.35 meters from the target. Pulse shape discrimination virtually eliminated gamma-ray background. Neutron spectra from targets of Ti and TiH_2 with a nominal thickness of ten micrometer were compared with targets of SiO_2, Si, C and Au to assess the importance of neutron backgrounds from triton reactions with the constituents of those targets. When the neutron spectra were transformed into profiles, the background corrected TiH_2 spectrum showed a uniform hydrogen concentration over ten microns. A measurement of the neutron spectrum produced when bombarding an Au target on which (t,n) reactions are strongly inhibited by the Coulomb barrier gives a yield equivalent to a background concentration of 3 at. % of hydrogen in Ti. This background is due to reactions on hydrogen, hydrocarbons, or other light nuclei on or in beam line components. Similar measurements on other targets gave background values equivalent to hydrogen atomic concentrations in Ti of: SiO_2-11 at. %, Si-7 at. %, C-22 at. %, Ti-5 at. %. Development of high senstivity for depth profiling hydrogen with this technique appears possible only for high Z host materials and will require careful attention to beam line and vacuum system design.

6306 **Low energy p—Be nuclear reactions for depth-profiling Be in alloys.** Pronko, P.P.; Okamoto, P.R.; Wiedersich, H. (Argonne National Lab., IL). *Nucl. Instrum. Methods;* **149**: 77-82(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

Beryllium distributions within the first micron of the surface of nickel- or copper-based alloys were investigated with a 300 keV proton probe utilizing low energy nuclear reactions. In the case of the Ni specimens, segregation of Be was induced by point defect flows to the surface of the specimen during Ni-ion bombardment at elevated temperatures. The nuclear reactions used for the detection of Be are $^9Be(p,d)^8Be$ with a Q value of 0.56 MeV and $^9Be(p,\alpha)^6Li$ with a Q value of 2.12 MeV. The deuteron and alpha groups are simultaneously observable using a standard surface barrier detector. Observations were made at a 150^0 scattering angle with and without a 2.5 μm mylar filter in front of the detector. This filter was found necessary for observing the deuteron yields since pulse pile-up from backscattered protons would otherwise mask the deuteron signal. The alpha group may be observed with or without the filter depend-

ing on whether counting statistics or energy resolution are the more important constraints. Significant Be segregation toward the surface was observed in specimens after irradiation at 625°C to 23 dpa with 3.2 MeV Ni ions. Concentrations of Be were nearly doubled within 500 A of the surface and a region depleted of Be extended below the surface layer to a depth of about 3000 A. These results are in reasonable agreement with predictions from computer calculations of alloy segregation induced by defect fluxes to free surfaces during irradiation at elevated temperatures.

6307 Use of $^{12}C(d,p)^{13}C$ and $^{16}O(d,p)^{17}O$ reactions to profile carbon and oxygen in solids. Borders, J.A.; Harris, J.M. (Sandia Labs., Albuquerque, NM). *Nucl. Instrum. Methods;* **149**: 279-284(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

The use of nuclear reactions for depth profiling carbon and oxygen in solids is discussed. A general expression for the yield from a nuclear reaction is derived and used to extract depth profiles from the energy spectra by two methods. The first method compares data from a target of unknown composition with a target containing a known concentration of either carbon or oxygen. By dividing the yields from the samples for equal collision energies, a concentration profile within the analyzed sample can be obtained. The second method uses published reaction cross-section data to obtain the profile. The (d,p) profiling is demonstrated for carbon in ScD_2. A comparison between the two methods is made by extracting carbon profiles in the near surface region of ScD_2 samples. Effects due to inaccurate stopping cross-section data are described. The technique is discussed for the $^{16}O(d,p)$ reactions used to profile oxygen along with the effect of interferences from the $^{2}H(d,p)^{3}H$ reaction and other reactions.

6308 Low-concentration oxygen depth profiling by the $^{16}O(d,\alpha)^{14}N$ reaction. Picraux, S.T. (Sandia Labs., Albuquerque, NM). *Nucl. Instrum. Methods;* **149**: 289-294(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

The $^{16}O(d,\alpha)^{14}N$ nuclear reaction is used for depth profiling low levels of ^{16}O by means of energy analysis of the emitted α-particles. The analytic method for converting the α-particle spectra to concentration vs depth profiles is presented, and the technique is applied to a variety of thin-film structures. Experimental methods for enhancing the depth resolution and sensitivity are discussed, and depth resolutions of 130 A and sensitivities of 0.3 at. % are demonstrated.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 5045

6309 (ANL—78-33) **Portable calorimeter system for nondestructive assay of mixed-oxide fuels.** Roche, C.T.; Perry, R.B.; Lewis, R.N.; Jung, E.A.; Haumann, J.R. (Argonne National Lab., IL (USA)). Apr 1978. Contract W-31-109-ENG-38. 29p. (ISPO—16). Dep. NTIS, PC A03/MF A01.

Calorimetric assay provides a precise, nondestructive method to determine sample Pu content based on the heat emitted by decaying radionuclides. This measurement, in combination with a gamma-spectrometer analysis of sample isotopic content, yields the total sample Pu mass. The technique is applicable to sealed containers and is essentially independent of sample matrix configuration and elemental composition. Conventional calorimeter designs employ large water-bath heat sinks and lack the portability needed by inspection personnel. The ANL air-chamber isothermal calorimeters are low-thermal-capacitance devices which eliminate the need for large constant-temperature heat sinks. These instruments are designed to use a feedback system that applies power to maintain the sample chamber at a constant electrical resistance and, therefore, at a constant temperature. The applied-power difference between a Pu-containing sample and a blank determines the radioactive-decay power. The operating characteristics of a calorimeter designed for assaying mixed-oxide powders, fuel pellets, and Pu-containing solutions are discussed. This device consists of the calorimeter, sample preheatr, and a microprocessor-controlled data-acquisition system. The small-sample device weighs 18 kg and has a measurement cycle of 20 min, with a precision of 0.1% at 10 mW. A 100-min gamma-ray measurement gives the specific power with a precision of better than 1% for samples containing 1 to 2 g of plutonium.

6310 Preparation of cellodextrins: an engineering approach. Huebner, A.; Ladisch, M.R.; Tsao, G.T. (Purdue Univ., West Lafayette, IN). *Biotechnol. Bioeng.;* **20**: No. 10, 1669-1677(Oct 1978).

The combination of Sephadex G-15 and ion-exchange resin columns allows one-step desalting and separation of cellodextrins using water as the sole eluent. The column apparatus described in this paper has the potential of producing up to 3 g cellodextrins in one day. In addition, the columns described are stable and do not require repacking or regeneration after each run. Hence the potential exists for scaling up this system for even greater production of cellodextrins if need be.

6311 Preparation and chromatographic applications of an amide resin. Orf, G.M.; Fritz, J.S. (Ames Lab., IA). *Anal. Chem.;* **50**: No. 9, 1328-1330(Aug 1978).

Synthetic routes are discussed for incorporation of a tertiary aliphatic amide group in a macroporous polystyrene—divinylbenzene resin. The amide resin retains uranium(VI), thorium(IV), and zirconium(IV) selectively from aqueous solution, pH 3.0. A liquid chromatographic separation scheme using the resin is given and quantitative results are obtained for uranium in synthetic and actual samples, and for thorium in synthetic samples. Gold(III) and palladium(II) are selectively retained by the resin from aqueous solutions containing hydrochloric acid. The resin has a capacity for gold of 1.7 mmol/g. 1 figure, 3 tables.

6312 Automated high accuracy method for carbon and hydrogen determination. Oita, I.J.; Babcock, R.F. (Standard Oil Co., Naperville, IL). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 120-127(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

A method and instrument are described for simultaneous determination of C and H in organic materials. A schematic diagram of the analyzer is presented and used in the description. Procedures and results are discussed. It is noted that the automated high accuracy unit has been in use for routine analysis since 1974 with no major maintenance problems. The combustion tube and filling generally last about two months, the carbon dioxide and water absorbers are changed daily, and the nitrogen oxide scrubber is changed about once a month. Although the number of samples that can be run per day varies with the type of sample, about 18 to 20 samples of typical non-volatile materials can be completed in one day by one operator running two units. Some catalyst samples require a pretreatment with nitrogen at 200°C to drive off adsorbed water which otherwise give high hydrogen results. In this case, the absorption tubes are disconnected, the snap valve for the oxygen line is closed and the sample is heated with nitrogen alone at a predetermined setting which will give 200°C in the heating zone. After one cycle, the oxygen valve is opened, the absorption tubes are connected, and the run is made in the usual way. Coal samples are treated in the same way, but with the preliminary heat treatment at 105°C.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 5068, 5222, 5360

6313 (DP—1474) **X-ray spectrometric determination of glass content of melts incorporating radioactive waste: a feasibility study.** Slates, R.V. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1978. Contract EY-76-C-09-0001. 26p. Dep. NTIS, PC A03/MF A01.

X-ray fluorescence spectrometry was evaluated for the determination of glass content and homogeneity of glass incorporating high-level radioactive waste. Accuracy and precision were determined for analyses of Al_2O_3, SiO_2, CaO, TiO_2, MnO, Fe_2O_3, and NiO in specimens of known composition. These specimens were prepared by fusing powdered glass with nonradioactive synthetic waste. Matrix effects of sodium on these analyses were specifically evaluated. X-ray fluorescence spectrometry was shown to be applicable to the proposed determinations by comparing the known glass contents of 14 glass waste compositions with those calculated from experimentally determined concentrations of SiO or TiO_2.

6314 (MLM—2533) **Feasibility study of the proposed use of automated x-ray fluorescence analysis for measurement of U and Pu in dissolver tanks.** Hudgens, C.R.; Craft, B.D. (Mound Lab., Miamisburg, OH (USA)). 11 Sep 1978. Contract EY-76-C-04-0053. 41p. Dep. NTIS, PC A03/MF A01.

This report treats the design parameters of a high-performance x-ray analyzer capable of precise analysis, without separation or concentration, of both U and the very dilute Pu in SRP dissolver tanks. Specifications were estimated so that the rms variation would not exceed 0.20%. Results indicate that the XRF system has high potential for improving dissolver tank accountability. (DLC)

6315 (UCRL—80937) **Improved x-ray fluorescence capabilities by excitation with high intensity polarized x-rays.** Ryon, R.W.; Zahrt, J.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 15p. (CONF-780822—2). Dep. NTIS, PC A02/MF A01.

From 27. conference on applications of x-ray analysis; Denver, CO, USA (1 Aug 1978).

Lowest detection limits are obtained by opening the collimator apertures until the system maximum counting rate is obtained. Selection of polarizer materials is discussed. A cylindrical polarizer is used in a high-intensity polarized x-ray source. (DLC)

6316 Profiling hydrogen in materials using ion beams. Ziegler, J.F. (IBM Corp., Yorktown Heights, NY); Wu, C.P.; Williams, P. *Nucl. Instrum. Methods;* **149**: 19-39(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

Over the last few years many ion beam techniques have been reported for the profiling of hydrogen in materials. Nine of these using similar samples of hydrogen ion-implanted into silicon were evaluated. When possible the samples were analyzed using two or more techniques to confirm the ion-implanted accuracy. Results of this work are reported which has produced a consensus profile of H in silicon which is useful as a calibration standard. The analytical techniques used have capabilities ranging from very high depth resolution (approximately equal to 50 A) and high sensitivity (<1 ppM) to deep probes for hydrogen which can sample throughout thin sheets (up to 0.2 mm thick).

6317 Studies of defects and surfaces by channeling. Barrett, J.H. (Oak Ridge National Lab., TN). *Nucl. Instrum. Methods;* **149**: 341-348(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

Uses of channeling to study defects and surfaces are reviewed briefly with emphasis on ways in which they are currently evolving. Consideration is first given to normalization of yields for channeling directions to the yield for a random direction, this normalization being important to the accuracy of both defect and surface studies. The discussion of atom location concentrates on the use that can be made of quantitative calculations of flux peaking. The treatment of surfaces includes accurate determination of the area of the surface peak as well as basic ways of extracting from experiments information on the positions of surface atoms. 33 references.

6318 Channeling analysis of stacking defects in epitaxial Si layers. Campisano, S.U. (Univ., Catania, Italy); Foti, G.; Rimini, E.; Picraux, S.T. *Nucl. Instrum. Methods;* **149**: 371-376(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

The channeling effect technique has been applied to investigate dechanneling by stacking defects in heteroepitaxially grown silicon. Ion backscattering was performed on 0.9 μm Si layers grown on sapphire as a function of beam energy (1.1 to 2.5 MeV He^+), projectile ion (He^+, D^+) and crystal direction ([100], [111], [112], [113]). Transmission electron microscopy analysis revealed the presence of a high density of stacking faults and twin lamellae. A model based on the new interior surfaces presented by such stacking defects is used to calculate the dechanneling cross section, and the disorder profiles are obtained from the experimental dechanneled fractions in terms of displaced rows per unit volume. Direct backscattering of channeled particles from the defects is neglected since the dechanneling cross section per row is about one order of magnitude larger than that per displaced atom. The resulting defect depth distributions are independent of beam energy and projectile ion, and give improved quantitative agreement with previous studies. The application of channeling to stacking-defect measurements requires a minimum density of approximately 10^{15} displaced rows/cm^2.

6319 Ion-induced optical emission for surface and depth profile analysis. White, C.W. (Oak Ridge National Lab., TN). *Nucl. Instrum. Methods;* **149**: 497-506(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

Low-energy ion bombardment of solid surfaces results in the emission of infrared, visible, and ultraviolet radiation produced by inelastic ion-solid collision processes. The emitted optical radiation provides important insight into low-energy particle-solid interactions and provides the basis for an analysis technique which can be used for surface and depth profile analysis with high sensitivity. The different kinds of collision induced optical radiation emitted as a result of low-energy particle-solid collisions are reviewed. Line radiation arising from excited states of sputtered atoms or molecules is shown to provide the basis for surface and depth profile analysis. The spectral characteristics of this type of radiation are discussed and applications of the ion induced optical emission technique are presented. These applications include measurements of ion implant profiles, detection sensitivities for submonolayer quantitites of impurities on elemental surfaces, and the detection of elemental impurities on complex organic substrates.

6320 Possible applications of a high brightness gallium source to ion microprobes. Ringo, G.R.; Krohn, V.E. (Argonne National Lab., IL). *Nucl. Instrum. Methods;* **149**: 735-737(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

A scanning ion microprobe with a resolution of 15 nm or better appears to be quite possible on the basis of a field-evaporation (EHD) ion source we have developed and a high efficiency system for production and collection of negative secondary ions. The possibilities of still better systems for the analysis of the secondaries using either stopping-power or laser-induced-fluorescence methods of identification are discussed briefly.

6321 (UCRL-Trans—11393) **Separation and determination of radioruthenium.** Watari, K. Translated from *Kagaku No Ryoiki;* **28**: No. 4, 298-306(1974). 30p. Dep. NTIS, PC A03/MF A01.

When analyzing ^{106}Ru in sea water at low levels of radioactivity, especially with sea water samples on the order of pCi/kg, the ordinary method of direct gamma-ray spectrometry will give analytical values distributed over a very wide range, and it is necessary to use an effect method of collection in order to concentrate the ^{106}Ru. At the present time, sulfide coprecipitation methods, especially the cobalt sulfide coprecipitation method, may be recommended. Furthermore, in gamma-ray spectrometry it will be necessary to pay careful attention to the difficulties in spectral analysis caused by the presence of other nuclides. In cases where chemical separation is followed by beta ray measurement, good results are given by methods in which the water samples are given basic oxidation treatment and ruthenium tetraoxide is then separated by solvent extraction. Concerning the method of chemical separation followed by beta ray measurement for algae, approximately the same things can be said as in the case of sea water. We may assume that analytical methods for ^{106}Ru in environmental samples have been more or less firmly established, although they have not yet been adopted sufficiently in countries around the world. The IAEA is currently going forward with its work of organizing the analytical methods which are recommendable at the present time.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 5063, 6344, 6481

6322 (BDX—613-1940) **Isotopic analysis of enriched boron by chemical ionization mass spectroscopy.** Hareland, W.A. (Bendix Corp., Kansas City, MO (USA)). 1977. Contract EY-76-C-04-0613. 21p. (CONF-771187—1). Dep. NTIS, PC A02/MF A01.

From 4. FACSS; Detroit, MI, USA (7 Nov 1977).

A rapid and accurate CI-MS method has been developed for the isotopic analysis of enriched boron. This method involves the formation of volatile methyl borate from boric acid with direct introduction of the methyl borate into the source of a quadrupole mass spectrometer. Data acquisition and storage is computer-controlled. A subsequent BASIC computer program reads the data from the disc file, computes the average $^{11}B/^{10}B$ ratio for up to 250 separate spectra per analysis and calculates the weight percent boron-10 from the corrected $^{11}B/^{10}B$ ratio using a calibration factor based on a National Bureau of Standards boric acid standard. The relative standard deviation for the analysis of replicate samples of enriched boron with a boron-10 content in the 90 to 95% range does not exceed 0.005%. Analytical results on NBS certified enriched boron agreed to within 0.06% absolute.

6323 (LBL—7688) **Various applications of Zeeman atomic absorption spectroscopy.** Koizumi, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 47p. (CONF-780681—1). Dep. NTIS, PC A03/MF A01.

From 61. chemical conference; Winnipeg, Manitoba, Canada (4 Jun 1978).

The application of the Zeeman effect to atomic absorption spectroscopy has been studied over the past several years. This technique has a larger area of application than conventional AAS because of its high degree of selectivity. The ZAA technique can be used for organometallic species determination by interfacing with a high-pressure liquid chromatograph. Various kinds of eluents can be directly introduced in the ZAA system; even organic solvents or high-concentration salt solutions. For example, the Co atom in the functional center of Vitamin B12 molecule was separately analyzed in the presence of much larger amounts of inorganic Co. In the ZAA technique, interference caused by direct spectral overlap can also be corrected. As a typical example, the Sb line at 217.02 nm overlaps the Pb absorption line at 217.00 nm. However, 1000 ppM of Pb did not cause any interference signal in the Sb analysis by ZAA. This is especially important in the analysis of gun powder residue that is often carried out by chemists working in the forensic field. In the determination of trace elements in matrices of unknown composition, the ZAA technique achieved highly reliable results by employing the standard addition method to correct for chemical interferences, because any nonspecific absorption or emission does not give rise to interference signals with this technique.

6324 (Y—2124) **Automated microprocessor-controlled atomic absorption analysis of natural water for arsenic and selenium.** Morrow, R.W.; Futrell, T.L.; Adams, T.T. (Oak Ridge Y-12 Plant, TN (USA)). Aug 1978. Contract W-7405-ENG-26. 17p. Dep. NTIS, PC A02/MF A01.

An automated, dual-channel atomic absorption spectrophotometer for the simultaneous determination of arsenic and selenium in natural water is now in operation. The instrument was constructed from commercially available optical components, spectral sources, and a sample changer. Automation was achieved by using an in-house-fabricated and programmed microprocessor. The instrument will analyze samples at a rate of 37 per hour, and a quantitative determination of arsenic and selenium to 0.2 μg/l (ppB) can be achieved. Arsenic can be determined with a precision of 19% at 1 μg/l and 6% at 10 μg/l, while selenium can be determined with a precision of 17% at 1 μg/l and 4% at 10 μg/l.

6325 **Quantitative detection of trace impurities in gases by infrared spectrometry of cryogenic solutions.** Freund, S.M.; Maier, W.B. II.; Holland, R.F.; Beattie, W.H. (Los Alamos Scientific Lab., NM). *Anal. Chem.;* **50**: No. 9, 1260-1262(Aug 1978).

A technique for considerably improving the sensitivity and specificity of infrared spectrometry as applied to quantitative determination of trace impurities in various carrier or solvent gases is presented. A gas to be examined for impurities is liquefied and infrared absorption spectra of the liquid are obtained. Spectral simplification and number densities of impurities in the optical path are substantially higher than are obtainable in similar gas-phase analyses. Carbon dioxide impurity (approximately 2 ppM) present in commercial Xe and ppM levels of Freon 12 and vinyl chloride added to liquefied air are used to illustrate the method.

6326 **Fluorescence line narrowing spectrometry in organic glasses containing parts-per-billion levels of polycyclic aromatic hydrocarbons.** Brown, J.C.; Edelson, M.C.; Small, G.J. (Ames Lab., IA). *Anal. Chem.;* **50**: No. 9, 1394-1397(Aug 1978).

Preliminary work on the application of this procedure is described. A 1 : 1 glycerol : water system containing the sample is cooled to < 4.2°K in a double nested helium Dewar which contains quartz optical windows. A control 553 Ar-ion laser is used for uv production. Spatial separation of the laser lines is achieved with external prisms, and detection electronics include a photon counting system as well as conventional analog equipment. A comparison of the line-narrowed fluorescence spectrum of pyrene in a 1 : 1 glycerol-ethanol glass at 4.2°K with that of pyrene in biphenyl and in fluorene at ca. 10°K is made. Representative spectra of anthracene (1.2 ppM), pyrene (224 ppB), and a mixture (100 ppB of each), in 1 : 1 glycerol: water at 4.2°K are displayed. The authors expect to implement this method as a practical analytical tool for the analysis of polynuclear aromatic hydrocarbons at very low concentrations in contaminated water samples.

6327 **High voltage and high resolution electron microscopy in materials science.** Thomas, G. (Univ. of California, Berkeley). *J. Met.;* vp(Feb 1977).

A brief review is given of the principles and some applications of transmission electron microscopy at high voltages and high resolutions. The combination of high resolution electron imaging and laser optical microdiffraction shows great promise for lattice parameter measurements over localized regions (approximately 10A) from which estimates of composition changes can be made.

6328 **Ultra-sensitive mass spectrometer system for quantitative biological studies.** Reynolds, W.D. (National Center for Toxicological Research, Jefferson, AR); Mitchum, R.K.; Newton, J.; Bystroff, R.I.; Pomernacki, C.; Brand, H.A.; Siegel, M.W. *Chem. Instrum.;* **8**: No. 2, 63-98(1977).

A dedicated minicomputerized high pressure ionization mass spectrometer with pulse-counting electronics was developed for quantitative biological studies using the molecular isotope dilution method. The two-chamber differentially pumped vacuum system maintained by two 800 l/s turbomolecular pumps contains a $^{3}/_{8}$-in. quadrupole analyzer, ion detector, and low pressure ion collection optics. Ions that are produced in the ion-molecule reaction chamber and initiated by the ^{63}Ni source are carried through a 40 μm aperture by the N_2 gas jet. The low pressure optics focus the ions into the quadrupole mass spectrometer while the bulk of the gas is pumped away. The signal from the pulse-counting detector is transmitted directly to a PDP 8/c minicomputer via an optically isolated, specially designed interface unit. Sensitivity in the single-ion monitoring mode for 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (5fg) has been determined.

6329 **Modular component optics system for use in laser analytical systems.** Wallin, B.W.; Johnson, D.C. (Univ. of California, Livermore). *Chem. Instrum.;* **8**: No. 4, 305-313(1977).

The use of lasers as irradiation sources for molecular fluorescence and spectroscopy has increased the sensitivity and selectivity of these analytical techniques. A new design approach has been taken to satisfy both the safety requirements of laser beam containment and the utilization of components for various analtyical techniques. This approach is in the form of a modular component optical system.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 5331, 6321, 6348, 6543, 6546, 6547, 6550, 6551, 6554, 6556, 6557, 6558, 6559, 6632, 6633, 6653

6330 **Effects of crown ethers on ion exchange behavior of alkali metals.** Delphin, W.H.; Horwitz, E.P. (Argonne National Lab., IL). *Anal. Chem.;* **50**: No. 7, 843-848(Jun 1978).

A study of the distribution coefficients (K/sub D/) of the alkali metals between solutions containing HCl or HNO_3-crown ether-80 percent (v/v) methanol and Aminex A7 resin was performed. The K/sub D/'s of Na between solution and resin phase were studied as a function of the methanol concentration, acidity, and crown ether concentration. Measured K/sub D/'s were compared to K/sub D/'s calculated from the independently measured partition coefficients and formation constants of the sodium crown ether complexes. Predictive modeling equations for the K/sub D/'s of the alkali metals in solutions containing either the A or B isomers of dicyclohexyl-18-crown-6 (DCH) were derived. These equations were used to devise separations of the alkali metals by high efficiency ion exchange chromatography. Finally, the chromatographic separation of the sodium isotopes, ^{22}Na and ^{24}Na, was investigated. Isotopic exchange constants for 18-crown-6 and DCH were measured as a function of temperature.

6331 **Chemically based model to predict distribution coefficients in the Cu—LIX 65N and Cu-KELEX 100 systems.** Hoh, Y.C.; Bautista, R.G. (Iowa State Univ., Ames). *Metall. Trans., B;* **9**: 69-75(Mar 1978).

A chemically based thermodynamic model to predict the distribution coefficients have been developed for the Cu-LIX 65N and Cu-KELEX 100 systems. The predictive model makes use of the aqueous phase cupric sulfate complex stoichiometric stability constant expressed as its degree of formation, their extraction mechnism, and the equilibrium constant for the extraction reaction. The distribution coefficient of copper can be predicted by the equation K/sub d/ = k_1α/sub o/phi^2, where phi is the ratio of the equilibrated organic concentration to the equilibrated hydrogen ion concentration in the aqueous phase, k_1 is the effective equilibrium constant containing the quotient of the activity coefficients of the reacting species and α_o is the degree of formation of the free cupric ion in the equilibrated aqueous phase. Excellent agreement between the experimental data and the predicted values was obtained. 6 figures, 4 tables.

6332 **Device for controlling and programming a pneumatic amplifier pump in a supercritical fluid chromatograph.** Conaway, J.E.; Smith, E.F.; Rogers, L.B. (Univ. of Georgia, Athens). *Chem. Instrum.;* **8**: No. 3, 167-180(1978).

Feedback from a pressure transducer at the pump output is used to activate a stepper motor to adjust an air regulator that controls the pump pressure. Control within 2.4% at 615 psig was obtained. In addition, linear pressure programs at flow rates between 0.2 and 2 cc/min were performed. Control or programming was limited only by the inherent range of the pressure transducer.

6333 **Ion-selective electrodes.** Herman, H.B. (Univ. of North Carolina, Greensboro). pp 103-120 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

The role of ion-selective electrodes in the detection and measurement of environmental pollutants is reviewed. The material is intended for the non-specialist in the area. First the theory of ion-selective electrodes is discussed. Included are sections on calibration curves, standard addition, selectivities and potentiometric titrations. Second a section is included on applications. Included are sections on reference electrodes, instrumentation and specific electrode types. The electrodes discussed are: glass type, silver sulfide type, fluoride, calcium, potassium, gas sensing and enzyme electrodes. They were chosen for their current and potential application to pollution analysis. A section on speculation about future applications of ion-selective electrodes concludes the paper.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 5072, 5202, 5323, 6302, 6355, 6357

6334 (BNL—24714) **Nuclear radiation as a probe of chemical bonding: the current interplay between theory and experiment.** Newton, M.D. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 106p. (CONF-7806106—1). Dep. NTIS, PC A06/MF A01.

From IAEA meeting on the use of nuclear radiation for the elucidation of chemical bonding; Cambridge, UK (27 Jun 1978).

After a survey of appropriate theoretical formalisms, recent confrontations of theory and experiment in the areas of neutron scattering, Moessbauer spectroscopy, and positron chemistry are discussed, with major emphasis on the degree to which simple concepts of chemical bonding can be refined by complementary use of the above experimental probes and the powerful techniques of computational quantum chemistry.

6335 (IS-T—813) **Synthesis and structural characterization of some compounds involving metal-metal bonding of tellurium, bismuth, and zirconium.** Cisar, A. (Iowa State Univ. of Science and Technology, Ames (USA)). Aug 1978. Contract W-7405-ENG-82. 153p. Dep. NTIS, PC A08/MF A01.

Salts of the tritelluride(2-) and tetrabismuthide(2-) ions with the complex cation (4,7,13,16,21,24-hexaoxa-1,10-diazabicyclo[8.8.8]hexacosane potassium) (abbreviated crypt K^+) were synthesized and their structures determined. The dark red (crypt $K^+)_2$ Te_3^{2-}.en was produced by oxidation of K_2Te with an excess of tellurium and the very dark green (crypt $K^+)_2Bi_4^{2-}$ was produced by the reaction of either K_3Bi, K_3Bi_2, K_5Bi_4, or KBi_2 with solvent. (Crypt $K^+)_2Te_3^{2-}$.en crystallizes in the trigonal space group $P3_2$ with a = 12.229(1)A and c = 31.242(4)A and three formula units per cell. The Te_3^{2-} ion has bond lengths of 2.692(5) and 2.720(4)A, an angle of 113.1(2)^0, and a hydrogen bond to an en molecule with d/sub Te-N/ = 3.46(6)A. (Crypt $K^+)_2Bi_4^{2-}$ crystallizes in the triclinic space group P anti 1 with a = 11.604(4)A, b = 11.796(4)A, c = 11.096(3)A, α = 98.12(3)^0, β = 98.02(3)^0, and γ = 61.37(3)^0 and one formula per cell. The structure of the more common form of stoichiometric $ZrCl_2$, which is isostructural with 3R-MoS_2, (R3m, with a = 3.3819(3) and c = 19.378(3)A) was refined from single crystal data. A cluster form which is isostructural with Zr_6I_{12} was found and its structure determined from powder data. 6T-Zr/sub 1+x/Cl_2 was determined from an intergrown "single" crystal containing 3R-$ZrCl_2$, to be a 6-slab superstructure based on a 2H/sub b/-MoS_2 type subcell with a = 3.3791(4) and c = 38.713(7)A. Another, 18T-Zr/sub 1+y/Cl_2, found in both single crystals and powder, has an 18 slab repeat sequence with a = 3.3820(2) and c = 116.21(2)A. The third is of unknown composition and exhibits ordering along a.

6336 (IS-T—820) **Synthesis and characterization of reduced scandium halide containing one- and two-dimensional metal bonded arrays.** Poeppelmeier, K.R. (Iowa State Univ. of Science and Technology, Ames (USA)). Aug 1978. Contract W-7405-ENG-82. 200p. Dep. NTIS, PC A09/MF A01.

The stabilization effect of metal-metal bond formation on reduced scandium compounds was studied. The binary compounds Sc_7Cl_{12}, Sc_5Cl_8, Sc_7Cl_{10} and ScCl were prepared by high temperature techniques and were characterized by single crystal x-ray diffraction. The respective metal arrays in these compounds can be viewed as fragments of scandium metal ranging from discrete six atom metal cluster species [$Sc(Sc_6Cl_{12})$], through intermediate single and double infinite chain configurations [$(ScCl_3)(Sc_4Cl_6)$]and [$(ScCl_2)(Sc_6Cl_8)$]to double metal close-packed sheets [ScCl]. The halogen atoms effectively isolate the clusters, chains and sheets by bonding face, edge or exo positions on the metal arrays. The common occurrence of isolated scandium (III) ions emphasizes that a minimum number of bonding electrons is required to stabilize what are formally anionic metal arrays. The distribution of the reduction electrons in these anisotropic materials was studied by magnetic susceptibility, EPR and uv-X photoelectron spectroscopy. The ternary compounds studied were $Cs_9Sc_2Cl_9$ and $CsScCl_3$. The anion-bridged metal chain of the hexagonal perovskite structure was found to stabilize scandium (II). $CsScCl_3$ was found to be grossly nonstoichiometric on the transition metal site and the effects of the mixed valence character were studied between the single valence extremes Cs_9Sc/sub 2 + x/Cl_9; 0< x < 1.0.

6337 (LBL—7827) **Basic energy properties of electrolytic solutions database.** Phillips, S.L.; Ozbek, H.; Otto, R.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 17p. (CONF-780587—3). Dep. NTIS, PC A02/MF A01.

From 6. CODATA conference; Palermo, Italy (22 May 1978).

A data center containing bibliographic and numerical data has been established to provide evaluated basic energy data on aqueous electrolyte solutions to elevated temperatures and pressures. Correlation equations and data are given for the viscosity, thermal conductivity, density, and enthalpy of aqueous sodium chloride solutions. (4 figs). (DLC)

6338 **Highly efficient electron-transfer processes over thermally activated alkaline earth oxides. Monolayer anion radical formation with nitrobenzene—MgO and high concentrations of CO radicals over MgO, CaO, SrO, BaO, and ThO_2.** Klabunde, K.J.; Kaba, R.A.; Morris, R. (Univ. of North Dakota, Grand Forks). *Inorg. Chem.;* **17**: No. 9, 2684-2685(Sep 1978).

Authors have attempted to determine quantitatively whether electron-transfer processes are of major importance on the surface of alkaline earth oxides and what types of sites are involved. Purified, powdered magnesium oxide was heat treated in vacuo overnight at 600°C. Total MgO/surface MgO molecules ratio was determined to be 9.4. Sample was treated with nitrobenzene. Color change from white to brown; radical formation was allowed to proceed for about 1 week. Spectra recorded during this period showed that maximum radical concentration was reached in 1 to 2 days at 25°C. Spin counts indicated that 20 to 25 surface molecules are necessary for the formation of the anion radical. Electron-transfer process appears to be extremely important on the surface even in a stoichiometric sense. Essentially, a monolayer of nitrobenzyl radical is formed on the surface of the MgO. Carbon monoxide studies were conducted. Maximum radical production was attained in 30 to 60 days. Evidence showed that the CO radical formation was much more selective process than the nitrobenzyl formation. Ca 15% of the CO adsorbed eventually formed radical species. The authors believe that the radical forming processes are not due to artifacts or to impurities, which could not possibly account for the number of radical species formed. They have concluded that coordination defects on the MgO surface are responsible for the reactivity. Further studies with other alkaline earth oxides are being conducted.

6339 **Relationship between porphyrin basicity and thiocyanate anation rates of cobalt(III) porphyrins in neutral detergent solutions.** Williams, G.N.; Hambright, P. (Howard Univ., Washington, DC). *Inorg. Chem.;* **17**: No. 9, 2687-2688(Sep 1978).

Authors report (a) a comparison of equilibrium and kinetic parameters for the complexation of thiocyanate by synthetic water-soluble cobalt(III) porphyrins both in the presence and in the absence of a neutral detergent, and (b) anation studies of water-insoluble cobalt(III) porphyrins of varying basicity in the same detergent media. The equilibrium constants, K, for SCN^- addition to the cobalt(III) porphyrins were determined spectrophotometrically. By using an excess of SCN^- over total porphyrin, the anation rate law was found to be first order in porphyrin. The observed rate constant, k/sub obsd/, was of the form k/sub obsd/ = K/sub f/ (SCN^-). Typical linear k/sub obsd/ vs. (SCN^-) plots are shown. The observed anation rate constants for cobalt uroporphyrin I were independent of pH between pH 1 and 2.5. Since pK/sub a/ values for the H_2O-Co/sup (III)/-P/HO/Co/sup (III)/-P reactions are above 4, H_2O-Co/sup (III)/-P is considered the reactant at pH 1.5. Co/sup (III)/-P-$(SCN)_2$ forms at much higher SCN^- concentrations than those used in this study, and k/sub f/ for the first SCN^- addition is orders of magnitude smaller than that for the second SCN^- process. Table I shows a comparison of equilibrium and kinetic results measured for three water-soluble porphyrins with and without the neutral detergent. Table II is a summary of the cobalt(III)-porphyrin anation data measured in the detergent. 2 figures, 2 tables.

6340 **Preparation and structures of the homologous quadruply bonded tris(cyclooctatetraene)dimolybdenum and -ditungsten.** Cotton, F.A.; Koch, S.A.; Schultz, A.J.; Williams, J.M. (Texas A and M Univ., College Station). *Inorg. Chem.;* **17**: No. 8, 2093-2098(Aug 1978).

The methods of preparation and the crystal and molecular structures of $Mo_2(C_8H_8)_3$ and $W_2(C_8H_8)_3$ are reported. The crystalline compounds, which are air-stable for periods of several days, can be prepared by reaction of the metal tetrahalides with $K_2C_8H_8$ in tetrahydrofuran. The Mo and W compounds, crystallizing in the space group I anti 4, are isomorphous with each other but not with $Cr_2(C_8H_8)_3$. The unit cell dimensions at 21 +- 1°C for $Mo_2(C_8H_8)_3$ are a = 15.815 (2) A, c = 15.014 (2) A, and V = 3755 (1) A^3 and for $W_2(C_8H_8)_3$ are a = 15.820 (3) A, c = 15.041 (3) A, and V = 3764 (2) A^3, with Z = 8. Both structures were determined by X-ray crystallography at 21 +- 1°C and that of $W_2(C_8H_8)_3$ has also been determined by neutron diffraction at 110°K, where the cell dimensions are a = 15.664 (3) and c = 14.980 (3) A. Each of these compounds has a molecular structure, essentially the same as that for the chromium homologue, in which the pair of closely bonded metal atoms (W-W = 2.375 (1) A and Mo—Mo = 2.302 (2) A) lies over one sharply folded ring which has all of its carbon atoms bonded to one or both metal atoms. Each metal atom also has attached to it an eta^4-C_8H_8 ring. The M—M bonds can be construed as quadruple. 8 tables, 2 figures.

6341 **Crystal and molecular structure of the decacoordinate compound ((hydroxyethyl)ethylenediaminetriacetato)diaquolanthanum(III) trihy-**

drate. Fuller, C.C.; Molzahn, D.K.; Jacobson, R.A. (Ames Lab., IA). *Inorg. Chem.;* **17**: No. 8, 2138-2143(Aug 1978).

The crystal and molecular structure of the trihydrate of (hydroxyethyl)ethylenediaminetriacetato)diaquolanthanum(III), $La[(O_2CCH_2)_2NCH_2CH_2N(CH_2CH_2OH)(CH_2CO_2)(H_2O)_2]\ .\ 3H_2O$ (triclinic, P anti 1, a = 9.476 (2) A, b = 10.947 (3) A, c = 9.391 (2) A, $\alpha = 108.18\ (2)^0$, $\beta = 104.66\ (3)^0$, $\gamma = 79.31\ (3)^0$, Z = 2, Mo Kα radiation), has been determined by three-dimensional X-ray analysis. The structure was solved by conventional Patterson and Fourier techniques and refined by a full-matrix least-squares procedure to a final conventional discrepancy factor, R = Σ[[F_o]-[F/sub c/]]/Σ[F_o], of 6.4% for 1637 observed reflections (F_o greater than 2 sigma/sub F_o/). This molecule crystallizes as a dimer, utilizing the crystallographic center of symmetry. The eight coordination sites satisfied by (hydroxyethyl)ethylenediaminetriacetate include five solely from one group--including one from the oxygen of the hydroxyethyl group--two by a sharing of a carboxymethyl oxygen between the two lanthanum atoms, and one from the carboxymethyl oxygen from the ligand primarily coordinated to the other lanthanum atom. The lanthanum cations are decacoordinate, with a geometry approximating the bicapped square antiprism.

6342 Telluride ion chemistry in molten salts. Toth, L.M.; Hitch, B.F. (Oak Ridge National Lab., TN). *Inorg. Chem.;* **17**: No. 8, 2207-2211(Aug 1978).

The Te^- ion has been shown to be the dominant telluride ion present in molten LiCl—KCl (59—41 mol %) and LiF—BeF_2 (66-34 mol %). It is characterized by an intense band at 497 and 478 nm in the respective solvents, epsilon 3370 L mol^{-1} cm^{-1}, and has a solubility limit of 8 x 10^{-3} mol % at 550°C in the chloride melt. Higher tellurides such as Te_3^- are also suggested in the chloride melts by the shift of the 497-nm band and the appearance of a second band at 650 nm. Prerequisites to reliable telluride ion control in molten salt solutions have been shown to be (1) the maintenance of Te_2 vapor in equilibrium with the melts and (2) the prevention of melt contact with oxidizing container materials such as silica. 5 figures.

6343 Matrix-isolation spectroscopy of aluminum, copper, and nickel hydrides and deuterides produced in a hollow-cathode discharge. Wright, R.B.; Bates, J.K.; Gruen, D.M. (Argonne National Lab., IL). *Inorg. Chem.;* **17**: No. 8, 2275-2278(Aug 1978).

By use of the technique of matrix-isolation spectroscopy in conjunction with a hollow-cathode sputtering source the infrared-active vibrations of the diatomic hydrides and deuterides of aluminum, copper, and nickel have been directly observed. The metal hydride and deuteride vibrations at 14°K in an argon matrix occurred as follows: AlH, 1593 cm^{-1}; AlD, 1158 cm^{-1}; CuH, 1882 cm^{-1}; CuD, 1356 cm^{-1}; NiH, 1906 cm^{-1}; NiD, 1374 cm^{-1}. 1 table, 3 figures.

6344 Polarized electronic absorption spectra for potassium tetrabromoplatinate(II) dihydrate. Spectral effects of a platinum(IV) component. Peters, T.J.; Kroening, R.F.; Martin, D.S. Jr. (Ames Lab., IA). *Inorg. Chem.;* **17**: No. 8, 2802-2807(Aug 1978).

Crystals of the metastable compound $K_2PtBr_4\ .\ 2H_2O$ have an orthorhombic structure, space group Pbam, with a:b:c = 8.31 (2):13.73 (3):4.84 (1) A and Z = 2. The $PtBr_4^{2-}$ ion occupies a crystallographic site of C/sub 2h/ symmetry but retains essentially a D/sub 4h/ molecular symmetry with the z axis directed along c. The absorption spectra in the d reverse → d region were recorded for a, b, and c polarizations. Band maxima lie at 300 to 800 cm^{-1} higher energies than in anhydrous K_2PtBr_4. The ^1A/sub 2g/ reverse → ^1A/sub 1g/ transition, forbidden in z polarization, was not observed in c polarization. Vibrational components were resolved in the ^3B/sub 1g/ shoulder and in the ^1A/sub 2g/ peak. Striking differences in intensities which occurred in the a and b polarization indicated that crystal effects were important in the vibronic excitation process. Red sections, in some crystals, were attributed to a dipole-allowed band, completely c polarized, for a mixed-valence electron-transfer transition involving a $PtBr_6^{2-}$ impurity defect. 6 figures, 3 tables.

6345 Structure of tris(bis(trimethylsilyl)amido)neodymium(III), $Nd[N(SI(CH_3)_3)_2]_3$. Andersen, R.A.; Templeton, D.H.; Zalkin, A. (Univ. of California, Berkeley). *Inorg. Chem.;* **17**: No. 8, 2317-2319(Aug 1978).

Data describe the structure of the titled compound and show that it is nonplanar. Crystal used in x-ray analysis was taken from a batch recrystallized from pentane, (0°C). Magnetic susceptibility measurements were obtained with a PAR Model 155 vibrating sample magnetometer employing a homogeneous magnetic field. A variable temperature liquid-helium system produced temperatures in the range of 4 to 100°K. X-ray diffraction defined space group. Setting angles of 12 manually centered reflections were used to determine by least-squares the cell parameters. For a molecular weight of 635.4 the calculated density is 1.04 g cm^{-3}. Intensity data were collected using the theta-2 theta scan technique with a scan speed of 29m on 2 theta. The absorption coefficient is estimated to be 15 cm^{-3}. A total of 3404 scans, not including standards, resulted in 917 unique reflections, 535 of which were greater than 2 sigma. The positions of the neodymium, nitrogen, and silicon atoms were deduced from a three-dimensional Patterson function. The carbon atoms were obtained from a subsequent least-squares and Fourier calculation--a series of which converged to the final structure. Expressions used in processing the data and estimating the weights are given in the supplementary material. Scattering factors were used and dispersion corrections were applied.

6346 X-ray photoelectron spectra of MnS, MnSe, and MnTe. Franzen, H.; Sterner, C. (Ames Lab., IA). *J. Solid State Chem.;* **25**: No. 3, 227-230(Jul 1978).

The core level binding energies and valence band spectra of MnS, MnSe, and MnTe have been examined by X-ray photoelectron spectroscopy. The results demonstrate that the compounds are substantially more ionic in character than related transition metal compounds, and that the compounds lack significant metal-metal interactions, accounting for the nontypical nature of the compounds as transition metal chalcides.

6347 Kinetics of oxidation of magnesium sulfite suspensions. Fedorova, S.K.; Alekseeva, L.A.; Gladkii, A.V. *J. Appl. Chem. USSR (Engl. Transl.);* **51**: No. 1, 20-23(Jan 1978).

Translated from Zh. Prikl. Khim.; Vol. 51: No. 1, 23-26(Jan 1978).

Study of the kinetics of oxidation of magnesium sulfite suspensions showed that sulfite ions are oxidized, regardless of pH. After disappearance of sulfite ions from the solution, pyrosulfite ions undergo oxidation but bisulfite ions do not. The order of the oxidation reaction with respect to sulfite ions and oxygen was determined. The reaction-rate constants and activation energy were calculated. The results of the investigation can be used in calculations of oxidation during removal of sulfur dioxide from gases by the magnesite method using an absorber with intensive mixing of the liquid phase.

6348 Sorption of ammonia by fibrous carbon sorbents with salt additives. Brun'ko, T.G.; Lazerko, G.A.; Morozova, A.A.; Ermolenko, I.N. (Belorussian State Univ., Minsk). *J. Appl. Chem. USSR (Engl. Transl.);* **51**: No. 1, 61-66(Jan 1978).

Translated from Zh. Prikl. Khim.; Vol. 51: No. 1, 67-71(Jan 1978).

The sorption capacity of fibrous activated carbon (FAC) can be raised four- to fivefold by introduction of salts capable of forming complexes with ammonia. The capacity of FAC depends on the nature of the added salt; the FAC capacity increases with decrease of the cation radius. The FAC studied have good kinetic sorption parameters and considerable capacity for ammonia; they can be regenerated by heat treatment and used repeatedly as sorbents.

6349 Recent advances in some optical experimental methods. Muller, R.H. (Univ. of California, Berkeley). *Electrochim. Acta;* **22**: 951-965(1977).

Light has been used as a nondestructive probe for the in situ investigation of processes at electrodes. The determination of concentration profiles near electrodes by optical interferometry has been improved by considering the bending of light in the boundary layer and its reflection from the electrode edge. Use of the Doppler shift of scattered laser light has been investigated for the measurement of convection velocities in boundary layers. The development of a fast and sensitive automatic ellipsometer has made it possible to follow the growth of surface layers at sizeable current densities. Consideration of the optical effect of mass-transport boundary layers on the observation of surface layers by ellipsometry has resulted in the novel use of ellipsometry for the determination of interfacial concentration at electrodes. A colorimetric analysis of interference colors, produced by thin films on electrodes, has shown that optimum angles of incidence exist for the observation of interference colors with polarized light. Interference color series have been derived theoretically which take phase change and amplitude attenuation in reflection into account.

6350 Porous barrier study of the temperature dependence of the mass spectrometer fragmentation pattern of LiF monomer. Mohazzabi, P.; Searcy, A.W. (Univ. of California, Berkeley). *Int. J. Mass Spectrom. Ion Phys.;* **24**: 469-470(1977).

The barrier effect (Ni powder) was used to determine the influence of temperature on the fragmentation patterns of LiF(g) and NaCl(g) upon collision with 70-eV electrons. The M_2X^+/MX^+ and M_2X^+/M^+ ion ratios were reduced to levels consistent with dimer/monomer equilibrium at the reduced exit fluxes. Ratios of apparent heats of vaporization of M^+ and MX^+ ions are close to unity. The fragmentation patterns are found to be independent of temperature. (DLC)

6351 MCSCF studies of chemical reactions: natural reaction orbitals and localized reaction orbitals. Ruedenberg, K.; Sundberg,

K.R. (Ames Lab., IA). pp 505-515 of Quantum science. Calais, J.L.; Goscinski, O.; Linderberg, J.; Oehrn, Y. (eds.). New York; Plenum Publishing Corp. (1976).

Interpretative concepts were developed to describe chemical reactions and those configurations whose energy lowering contributions will change during the reaction by comparable amounts were developed in terms of the molecular configuration self-consistent field approach. Natural reaction orbitals, localized reaction orbitals, and examples of these in 1,2-dioxetane are discussed.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 6343

6352 (COO—3498-34) **Fundamental studies in isotope chemistry between Division of Research, U.S. Energy Research and Development Administration and University of Rochester. Progress report, 1 July 1977—30 June 1978.** Bigeleisen, J.; Harris, T.H. (Rochester Univ., NY (USA)). 1978. Contract EY-76-S-02-3498. 45p. Dep. NTIS, PC A03/MF A01.

This is a continuing program of basic research in isotope chemistry. Both theoretical and experimental studies complement each other to elucidate the fundamentals of isotope chemistry and to utilize this tool for the study of the fundamental properties of matter. Such studies have led to important separation processes of technological interest in the past and may provide the scientific base for future separation processes. Recent concerns concerning the potential impact of CO_2 from the combustion of fossil fuel and the formulation of the national climate program stress the importance of isotope effect studies to practical problems in the evolving national energy program and the world climate program.

6353 **Isotopic mixing in carbon monoxide catalyzed by zinc oxide.** Carnisio, G. (Donegani Research Inst., Novara, Italy); Garbassi, F.; Petrini, G.; Parravano, G. *J. Catal.;* **54**: No. 1, 66-80(Aug 1978).

The rate of the isotopic mixing in CO has been studied at 300°C, for CO partial pressures from 6 to 100 Torr and a total pressure of 250 Torr on ZnO catalysts. Significant deviations from a first-order rate in p/sub co/ were found. The rate of oxygen exchange between ZnO and gas-phase CO was also measured and the results were employed to calculate the fraction of surface sites active for the CO isotopic mixing. Values on the order of 0.001 were found. The turnover rate and surface collision efficiency varied between 0.7 and 107 min^{-1} and 0.13 and 2.24 x 10^{-8}, respectively. H_2 additions to CO increased the rate of isotopic mixing, whereas the rate of H_2 + D_2 was decreased by the presence of CO. The H_2 + D_2 rate was faster than that of isotopic mixing in CO, but as the ratio p/sub H_2// p/sub co/ decreased the rates became about equal. It is argued that on ZnO samples, in which the rate of CO isotopic mixing and the rate of ZnO—CO oxygen exchange were influenced in a similar manner by the CO pressure, the isotopic mixing in CO took place via the ZnO oxygen, while oxide oxygen participation was not kinetically significant for ZnO samples in which the two reactions had different kinetics. The crucial factor controlling the path followed by the isotopic mixing in CO seems to be the surface Zn/O ratio, since a close correlation was found between the former and the reaction kinetics of the CO isotopic mixing reaction. Solid-state conditions which may vary the Zn/O surface ratio (foreign additions) are indicated. The implications of these findings to the problem of product selectivity from CO-H_2 mixtures reacting on metal oxide surfaces are discussed.

6354 **Isotope effect in the study of H—W(100) and O—W(100) chemisorption systems using SIMS.** Yu, M.L. (Brookhaven National Lab., Upton, NY). *Nucl. Instrum. Methods;* **149**: 559-561(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

Large isotope effects were observed in the secondary ion yields when chemisorbed layers of H, D, ^{16}O, and ^{18}O on W(100) were sputtered with low energy Ne^+ ions. Higher isotopic mass in general lowered both the atomic ion yields (H^-, D^-, O^+ and O^-) and the molecular ion yield (WO^-_2), except for H^+ (D^+) where the converse was true.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 6352

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 6302, 6345

6355 (CONF-771203—, pp 53-54) **Acetylene production from coal or hydrocarbons via CaC_2 in plasmas.** Kim, C.S.; Baddour, R.F.; Howard, J.B.; Meissner, H.P. (Massachusetts Inst. of Tech., Cambridge). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6356 (COO—1198-1220) **Configurational statistics of confined polymer chains.** Lohse, D.J. (Illinois Univ., Urbana (USA). Dept. of Metallurgy and Mining Engineering). 1978. Contract EY-76-C-02-1198. 225p. Dep. NTIS, PC A10/MF A01.

Thesis.

The work on confined chain statistics is reviewed. The work on the general statistics is discussed first, and then some of the theories for the applications of statistics are considered. Two methods for determining the general statistics of a confined chain are discussed. The first is the method of images. The second method involves the use of differential equations. In a specific case the statistics of the unconfined chain are chosen to be defined by the Gaussian real chain distribution. The confinement is provided by two parallel walls. The distribution for the four possible types of chains, bridges (tie chains), loops, cilia (dangling chain ends), and floating (unattached) chains, are derived. These statistics are then applied to two polymer systems in which the confinement is due to internal surfaces, semicrystalline polymers and block copolymers. Both systems are modelled by chains between two walls for a number of morphologies. Mechanical properties are calculated for both systems and for block copolymers swelling is also considered. The main result of this work is that there are two effects which determine the behavior of the chains in these systems. The first is the effect of the confinement which operates on all the chains, since the mode of attachment is not important. The confinement reduces the number of configurations available to the chains. This effect is larger the closer the walls are, relative to the length and stiffness of the chains. The second effect operates only on bridges, since it requires that the ends of the chain be attached to different walls. This is the inherent elastic nature of the bridge, which means that the number of configurations is reduced when it is stretched beyond its equilibrium length. All the behavior calculated here can be explained by these two effects.

6357 **Some new thermochromic complexes of Ni(II) of the type [R/sub x/NH/sub 4-x/]$_2$NiCl$_4$.** Ferraro, J.R.; Sherren, A.T. (Argonne National Lab., IL). *Inorg. Chem.;* **17**: No. 9, 2498-2502(Sep 1978).

A new group of thermochromic complexes of Ni(II) of the type [R/sub x/NH/sub 4-x/]$NiCl_4$ have been synthesized, where R is an alkyl aryl group. These complexes have been prepared from the melt of 2:1 mole ratios of R/sub x/NH/sub 3-x/HCl and anhydrous $NiCl_2$. The complexes are brown-yellow to green-yellow at room temperature and turn blue upon heating to the thermochromic temperature (T/sub c/). Magnetic susceptibility, far-infrared spectra, and X-ray powder diffraction patterns indicate that the room-temperature phase is polymeric, containing octahedrally coordinated metal ions with bridging chlorine atoms. The hydrogen bonding from the substituted ammonium cation is important for maintaining the structure. Magnetic susceptibility and absorption and far-infrared spectra indicate that the blue phase involves discrete tetrahedral $NiCl_4^{2-}$ ions. The thermochromism is reversible and the T/sub c/ may be controlled by the degree of hydrogen bonding available from the alkyl- or arylammonium group, by the nature and the size of the R group, and by the nature of the halogen atom in the anion. Similaries with the [R/sub x/NH/sub 4-x/]$_2CuCl_4$ complexes are discussed. 4 figures, 2 tables, 42 references.

6358 **Structural studies of precursor and partially oxidized conducting complexes. 19. Synthesis and crystal structure of $Cs_2[Pt(CN)_4]Cl$/sub 0.30, the first anhydrous one-dimensional tetracyanoplatinate chloride complex.** Brown, R.K.; Williams, J.M. (Argonne National Lab., IL). *Inorg. Chem.;* **17**: No. 9, 2607-2609(Sep 1978).

The preparation and single-crystal x-ray structural characterization of a new, partially oxidized tetracyanoplatinate (POTCP), $Cs_2[Pt(CN)_4]Cl$/sub 0.30/, CsCP(Cl), has been carried out. This one-dimensional conducting salt crystallizes with four formula units in the tetragonal unit cell I4/mcm, with cell constants a = 13.176 (2) A, c = 5.718 (1) A, and V = 992.7 A^3. A total of 3112 observed data were averaged to yield 427 independent reflections. The structure was solved by standard heavy-atom methods and was refined by full-matrix least squares to a final $R(F_o^2)$ = 0.045 and R/sub w/ (F_o^2) = 0.059. Pertinent structural features include perfectly linear chains of Pt atoms with Pt-Pt separations crystallographically constrained to a value of (c/2) = 2.859 (2) A and interchain Pt-Pt distances of 9.317 A. Separations between the Cs^+ and Cl^- ions are significantly shorter than the sum of the ionic radii. A discussion of

these unusually short interionic distances and the absence of hydration as determined from the structural study and themogravimetric analyses is given. 2 figures, 2 tables.

6359 Mechanistic aspects of the catalyzed hydroperoxide epoxidation. Kollar, J. (Redox Technologies Inc., Wyckoff, NJ). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 106-112(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Mechanisms involved in the transition metal catalyzed hydroperoxide epoxidation of olefins are discussed. The effects of structure and catalysts are discussed along with the effects of high and low activation energy mechanisms. It is noted that on partial hydrolysis these catalysts cannot function via the low activation energy mode; the reason is probably centered around steric considerations. (JRD)

6360 Stabilities of carbonium ions in solution. VI. A low temperature calorimetric approach to enthalpies of formation of carbocations in solution. Arnett, E.M.; Petro, C. (Univ. of Pittsburgh). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 128-140(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

A search was made for conditions and techniques which would permit reliable colorimetric study of the quantitative conversion of saturated compounds to carbonium ions in solution. Methods were found that lead to heats of ionization which are sufficiently reproducible to permit comparison of simple aliphatic compounds whose heats of ionization differ by 1 kcal/mole. They can also be compared with gas phase data on carbonium ion stabilities or solvolysis rates of reactions presumed to go through cationoid transition states. No conductive data are available on simple carbonium ion systems in superacids. However, nmr studies on such systems give almost irrefutable evidence of ionization on the following grounds: large downfield shifts relative to the precursor are always observed and the spectrum of the preserved ion is not dependent on whether it is formed from the appropriate halide, alcohol or olefin; all ^{19}F-^{1}H coupling vanishes when fluoride precursors are used; and the spectra of ions which would be expected to undergo rapid hydride and alkyl shifts are readily interpreted in terms of line-broadening kinetics, such spectra bear only a remote similarity to those of the precursors which however may be recovered from the superacid solutions. It is believed that there is an enormous weight of evidence that the methods described are appropriate for measuring the enthalpy of carbonium ion formation in superacid solution.

6361 Hydropyrolysis of model compounds. Ramakrishnan, R.; Shabtai, J.; Oblad, A.G. (Univ. of Utah, Salt Lake City). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 159-162(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

The chemical reactor design is discussed along with the effects of hydrogen on the thermal cracking of hexadecane at high pressure. Results show that paraffin/olefin ratios in the C_3—C_4 fractions are much higher in hydropyrolysis than those in thermal cracking and increase sharply in the 500 to 2000 psig range. The ratios are not equilibrium controlled but apparently kinetic controlled both in thermal cracking and hydropyrolysis. In hydropyrolysis, the relative yield of CH_4 is considerably lower, whereas those of C_3—C_5 components are markedly higher than observed in thermal cracking. For components greater than C_5, mostly olefins are formed in thermal cracking whereas mostly paraffins are formed in hydropyrolysis. Low yields of aromatics and products higher than the starting material are formed by hydropyrolysis; whereas in thermal cracking, especially under pressure, there is considerable formation of aromatics and high boiling products. Differences in product distribution, especially C_1—C_5 components, can be attributed to anticipated differences in the reaction mechanisms of the two processes.

6362 Pyrolysis of acetylene, butadiene, and benzene in different tubular reactors. Albright, L.F.; Yu, Y.H.C. (Purdue Univ., West Lafayette, IN). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 1, 218-224(Feb 1978). (CONF-770814—P2; CONF-780305—P2).

From American Chemical Society meeting; Chicago, IL, USA (29 Aug 1977).

Several important reactions occur on the inner surfaces of the high alloy steel tubes employed for pyrolyses of these compounds. These surface reactions occur simultaneously and consecutively with the gas-phase reactions that produce the desired products of pyrolysis. Most surface reactions are undesired and lead to production of significant amounts of coke, carbon oxides, hydrogen and methane. Surface reactions that occur in addition to coking and decoking include oxidation, reduction, sulfiding, and desulfiding of the inner surfaces of the high-alloy stainless-steel reactors. The pyrolysis reactors were 1.10 to 1.26 cm ID tubes that were heated in an electrical resistance furnace over a length of about 48 cm. The materials of construction in the four reactors employed in this investigation were as follows: Incoloy 800, SS304, Vycor glass, and alonized Incoloy 800. Results of acetylene pyrolysis are given along with those for butadiene, and benzene. Although more information is needed to determine details concerning factors that favor inactive coke formation, relatively high levels of surface sulfides probably promote formation of such coke. Metal oxides on the surface likely favor production of active coke. Sulfiding the reactor tube immediately upon completion of the decoking step would form metal sulfides. An aluminized surface such as provided by the alonized Incoloy 800 reactor has also been found to be an effective way to prevent the production of active coke. Possibly the initial type of coke formed on the just cleaned tube would have an important effect on the length of time a reactor tube could be used in a commercial plant before decoking would be required.

6363 Diaveridine: 2,4-diamino-5-(3',4'-dimethoxybenzyl)pyrimidine. Koetzle, T.F.; Williams, G.J.B. (Brookhaven National Lab., Upton, NY). *Acta Crystallogr., Sect. B;* **34**: 323-326(1978).

$C_{13}H_{16}N_4O_2$, M/sub r/ = 260.92, crystallizes from wet ethanol in the monoclinic space group C2/c, a = 18.140(5), b = 12.796(3), c = 12.332(3) A, β = 114.78(1)°. D/sub c/ (for eight molecules in the cell of volume 2598.93 A^3) = 1.169 g cm^{-3}. The structure was solved with MULTAN and refined by full-matrix least-squares techniques based upon 1838 unique F^2_o terms to yield agreement factors R = 0.057 and R/sub w/ = 0.089.

6364 Structure of 6-O-α-D-galactopyranosyl-(α,β)-D-glucopyranose(α,β-melibiose) monohydrate. Gress, M.E.; Jeffrey, G.A.; Rohrer, D.C. (Brookhaven National Lab., Upton, NY). *Acta Crystallogr., Sect. B;* **34**: 508-512(1978).

This structure analysis of $C_{12}H_{22}O_{11}.H_2O$ [orthorhombic, $P2_12_12_1$, a = 8.900(2), b = 10.894(1), c = 15.868(3) A] differs from two recently reported independent analyses in that the component of the β anomer is 28% instead of 15% and 20%. There are significant differences in the cell parameters of the three structures and a minor difference in the interpretation of the hydrogen bonding.

6365 Comprehensive thermodynamic studies of seven aromatic hydrocarbons. Finke, H.L.; Messerly, J.F.; Lee, S.H.; Osborn, A.G.; Douslin, D.R. (Bartlesville Energy Research Center, OK). *J. Chem. Thermodyn.;* **9**: 937-956(1977).

Heat capacity and enthalpy of transition were measured for phenanthrene, acenaphthene, fluorene, 1,2'-dinaphthylmethane, 1,8-,2,6-, and 2,7-dimethylnaphthalene from 10 to about 440°K in order to provide experimental data for deriving the following thermodynamic quantities over a range of temperature of the condensed phases and the perfect gas state: [H/sub s2(T) - H°(0)], [S/sub s/(T) - S(0)], C/sub s/, [H°(T) - H°(0)], S°, ΔH°/sub f/, ΔS°/sub f/, ΔG°/sub f/, and $\log_{10}$K°/sub f/. Experimental values for the condensed states were converted to gaseous-state values with the aid of enthalpies of vaporization derived from vapor pressures and the Clapeyron equation. Linear relations of ΔG°/sub f/ against T were used to extrapolate to standard values at 298.15 K. (3 figures, 7 tables)

6366 6-endo-hydroxy-3-endo-aminomethylbicyclo[2.2.1]heptane-2-endo-carboxylic acid lactam. Olson, A.J.; Templeton, D.H.; Templeton, L.K. (Univ. of California, Berkeley). *Acta Crystallogr., Sect. B;* **33**: 2266-2269(1977).

$C_9H_{13}NO_2$, monoclinic, $P2_1/c$, 23°C, a = 10.870(3), b = 7.403(2), c = 10.721(4) A, β = 107.46(2)°, Z = 4,D/sub x/ = 1.350(2), D/sub m/ = 1.35(1) g cm^{-3}. For 1169 reflections with I > sigma, R = 0.055 and R/sub w/ = 0.051. The O(hydroxyl)-C(carbonyl) distance is 2.832 A, two H atoms are 2.00 A from each other, and these distances would be even shorter except for distortion of some of the bond angles. Hydrogen bonds from the hydroxyl and amide groups to the carbonyl O atom link the molecules into chains.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 6382

6367 Preparation of highly enriched diazomethane-d_2. Markey, S.P.; Shaw, G.J. (National Inst. of Mental Health, Bethesda, MD). *J. Org. Chem.;* **43**: No. 17, 3414-3415(18 Aug 1978).

Deuterated diazomethane (CD_2N_2) of 99% isotopic purity was prepared by phase transfer catalyzed multiple exchanges with D_2O using a diethyl ether solution of CH_2N_2 with NaOD and D_2O. If solutions and flasks were kept cold and basic, 25 to 35% of theoretical yield was obtained after five exchanges.

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 6337

6368 (TID—28677) **Electrochemistry of acetylides, nitrides, and carbon cathodes in molten halides. Progress report, May 1978.** Selman, J.R. (Illinois Inst. of Tech., Chicago (USA)). 1978. Contract EG-77-S-02-4445. 11p. Dep. NTIS, PC A02/MF A01.

An inert-atmosphere glove-box with oxygen and moisture removal capability and with attached furnace well for experiments up to 1000°C has been installed and equipped. Work on the glove-box and ancillary equipment is now nearly complete; initial experiments to measure the emf's of acetylide-containing cells will be carried out during the remaining contract period. The emf data obtained earlier on acetylide-containing cells have been re-interpreted in terms of a mixed potential concept. It is concluded that the reaction kinetics of acetylide ion discharge are fast and that the reaction rate constant is comparable to that of lithium metal underpotential deposition at carbon. A modeling study of the discharge of porous lithium-aluminum electrodes has been supported.

PHOTOCHEMISTRY

6369 Photochemical generation of metastable methylcopper complexes. Oxidation-reduction of methyl radicals by copper complexes. Ferraudi, G. (Univ. of Notre Dame, IN). *Inorg. Chem.;* **17**: No. 9, 2506-2508(Sep 1978).

Methyl radicals, generated by flash irradiations of $Co(NH_3)_5OCOCH_3^{2+}$, were intercepted with Cu^{2+} (aq) and Cu^{+} (aq) ions. Metastable species, formed in these reactions, were assigned as $CuCh_3^{2+}$ (lambda/sub max/ less than or equal to 350 nm) and $CuCH_3^{+}$ (lambda/sub max/370 nm). A transient, assigned also as $CuCH_3^{+}$, was observed in irradiations of $CuOCOCH_3^{+}$. Product yields were measured in order to confirm the nature of the transients. 1 table, 2 figures.

6370 Kinetics of dark back reactions of products of the photoreduction of triplet thionine by iron(II). Evidence for association of leucothionine and semithionine with iron(III). Osif, T.L.; Lichtin, N.N.; Hoffman, M.Z. (Boston Univ.). *J. Phys. Chem.;* **82**: No. 16, 1778-1784(10 Aug 1978).

Data obtained by flash photolysis-kinetic spectrophotometry at 23 +- 2°C show that the pseudo-first-order specific rate of oxidation of leucothionine by Fe(III) at constant pH, ionic strength, identity of anions, and solvent approaches a limiting value with increasing [Fe(III)]. The results can be quantitatively rationalized by assuming rapid reversible association of Fe(III) with leucothionine (K_7 approximately 10^3 M^{-1}) followed by a relatively slow (k_8 approximately 1 s^{-1}) intramolecular electron transfer. The dependence of K_7k_8, the apparent second-order rate constant for reaction of leucothionine with Fe(III), upon solvent (H_2O vs. 50 v/v % aqueous CH_3CN), pH (1.1-2.7), anions (Cl^- vs. SO_4^{2-}/HSO_4^-), and ionic strength (0.05-0.5) has been examined. Steep increase in K_7k_8 with increasing pH and substantial dependence on nature of anions (faster with Cl^-) are the most prominent effects observed. Dissociation of a proton from the addition complex is postulated to rationalize the dependence on pH. Analogous data suggest association of reactants as a step in the faster oxidation of semithionine by Fe(III), apparent second-order rate constant, k_9 approximately (0.2-9) x 10^5 M^{-1} s^{-1}, depending on medium. Information on the dependence of the specific rate of disproportionation of semithionine upon solvent, pH, nature of anions, and ionic strength has also been collected. Variation of both K_7k_8 and k_9 with nature of the solvent and anions is consistent with the greater efficiency of totally illuminated-thin layer iron-thionine photogalvanic cells observed with 50 v/v % aqueous CH_3 CN as solvent and SO_4^{2-}/HSO_4^- as anions. 4 tables, 5 figures, 38 references.

6371 Resonance energy transfer between diphenylmethylene and fluorescein at 77 K. Wu, K.C.; Trozzolo, A.M. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **82**: No. 16, 1827-1830(10 Aug 1978).

A resonance radiationless energy transfer process has been found between the excited state of diphenylmethylene (a molecule with a triplet ground state) and fluorescein in a rigid alkaline glass at 77°K. By measuring the effect of fluorescein on the lifetime of excited diphenylmethylene, the critical transfer distance R_0 was found to be 61 A. This compares favorably with the theoretical value of 50 A calculated by the Forster weak-interaction dipole treatment. This is the first example of the dipole-allowed radiationless energy transfer of the type $^3D^* + {}^1A \rightarrow {}^3D + {}^1A^*$. 3 figures.

6372 Function of cyclic electron transport in photosynthesis. Slovacek, R.E.; Mills, J.D.; Hind, G. (Brookhaven National Lab., Upton, NY). *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **87**: No. 1, 73-76(Mar 1978).

Experiments are described which differentiate between cyclic and pseudocyclic phosphorylation, and assess their relative contribution to ATP synthesis in the intact chloroplast.

RADIATION CHEMISTRY

6373 (BNL—50781) **Radiation effects on ion exchange materials.** Gangwer, T.E.; Goldstein, M.; Pillay, K.K.S. (Brookhaven National Lab., Upton, NY (USA)). Nov 1977. Contract EY-76-C-02-0016. 154p. Dep. NTIS, PC A08/MF A01.

An extensive literature review and data compilation has been completed on the radiation-damage of ion exchange resins. The primary goal of the study has been to review the available literature on ion exchange materials used in, as well as those with potential for use in, the nuclear fuel and waste reprocessing areas. The physical and chemical properties of ion exchangers are reviewed. Experimental parameters useful in characterizing the effects of radiation on synthetic ion exchange resins are identified or defined. In compiling the diverse types of data, an effort was made to present the experimental data or experimentally based parameters in a format that would be useful for inter-comparing radiation effects on resins. When subject to radiation there are various general trends or qualitative effects displayed by the different types of resins. These radiation-trends and effects have been formulated into qualitative statements. The present day level of understanding of the behavior of resins under ionizing radiation is too limited to justify quantitative predictive modeling. The limitations and deficiencies of the literature are discussed and the experimentation needed to achieve quantitative modeling are outlined. 14 figs., 108 references.

6374 Activated and activationless localization in impurity trapping of the dry electron in methanol and propanol. Rate constants for solvated electrons. Razem, D.; Hamill, W.H. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **82**: No. 13, 1460-1465(29 Jun 1978).

Dry-electron trapping by impurity competes with localization by the medium. Observations in the range 80 to 300 K for methanol and 1-propanol provide evidence that each of these processes has activated and activationless components, most clearly shown for methanol. The activationless processes dominate below approximately 150 K. They are considered to resemble electron resonances in the gas phase, the energy being supplied by the electron, as for benzene. The disordered medium converts potential energy of electronic polarization to kinetic energy by scattering. The rate constants for scavenging solvated electrons do not correlate with dry-electron scavenging efficiencies over the range approximately 5 x 10^6 to 5 x 10^8 M^1s^{-1}, and only correlate poorly with the enthalpy of activation. For each scavenger the rate constants change systematically from solvent to solvent. 2 tables, 6 figures.

6375 Laser induced resonance Raman and fluorescence studies of the α-hydronaphthyl radical in the irradiated naphthalene crystal. Jacobsen, C.W.; Hong, H.K.; Sheng, S.J. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **82**: No. 13, 1537-1540(29 Jun 1978).

Resonant Raman and fluorescence studies of α-hydronaphthyl radicals produced by ionizing radiation of the naphthalene crystal are reported here. A resonant enhancement factor of the order of 10^8 for Raman scattering from this radical was observed. The vibrational structure of the Raman and fluorescence from this radical are analyzed in analogy to the parent naphthalene molecule. Several origins due to site splitting and other species in the irradiated sample are observed. 4 figures, 1 table.

6376 Rate constants and mechanisms of reaction of Cl_2^- radicals. Hasegawa, K.; Neta, P. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **82**: No. 8, 854-857(20 Apr 1978).

The rate constants for reaction of Cl_2^- with various organic and inorganic compounds were determined by kinetic spectrophotometric pulse radiolysis. The Cl_2^- radical can abstract hydrogen from aliphatic compounds with rate constants that vary from 7 x $10^3M^{-1}s^{-1}$ for t-BuOH to 1.9 x $10^6M^{-1}s^{-1}$ for HCO_2^-. The reaction with olefinic compounds results in Cl atom addition and takes place with generally higher rate constants, ranging from approximately $10^6M^{-1}s^{-1}$ for double bonds deactivated by adjacent cyano or carboxyl groups to approximately 6 x $10^8M^{-1}s^{-1}$ for allyl alcohol and sorbic acid, for example. Addition to an aromatic ring can also take place with kappa $<$ or $=$ to $10^7M^{-1}s^{-1}$ but the important reaction of Cl_2^- with the aromatic compounds is the direct oxidation by electron transfer. Such oxidation is possible when the ring is substituted with OH, OCH_3, NH_2, and related groups. The cation radical produced from a methoxy substituted compound was identified by both optical and ESR spectra. The cation radicals from hydroxy or amino substituted compounds undergo deprotonation to produce the phenoxyl or anilino radicals. The reaction of Cl_2^- with inorganic compounds was also found to involve either hydrogen abstraction or one-electron oxidation for the differenr compounds studied. 1 figure, 3 tables.

6377 An electron spin resonance study of the photolysis of trapped radicals in γ-irradiated carboxylic esters at 77-87K. Hudson, R.L.; Williams, F. (Univ. of Tennessee, Knoxville). *J. Phys. Chem.;* **82**: No. 8, 967-969(20 Apr 1978).

Experiments with methyl propionate and polycrystalline and glassy samples of ethyl acetate at 77°K have confirmed the findings that the 24-G doublet spectrum of the radical anion is present immediately after γ-irradiation and is photobleachable with visible light, producing ethyl radicals. Therefore, photobleaching of the radical anion, $RC(O^-)$ OR′ by visible light generates the alkyl radical R′ by a process of β-scission. Further bleaching of an ethyl acetate sample with light from a high-pressure mercury-arc lamp using a 420nm cutoff filter to give a 280 to 420nm band-pass, showed removal of the $CH_3CO(O)OCHCH_3$ radical and production of a strong asymmetric singlet spectrum. Additional photobleaching with visible light resulted in the loss of the singlet and the production of methyl radicals. Evidently the radical responsible for the asymmetric singlet spectrum is an intermediate in the photobleaching of the $CH_3CO(O)OCHCH_3$ radical to give the methyl radical. Since the acetyl radical is known to give the methyl radical on the photobleaching with visible light, it is, chemically, the most likely intermediate.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

HOT-ATOM CHEMISTRY

REFER ALSO TO CITATION(S) 6860

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 5323, 6241, 6256, 6283, 6311, 6848

6378 (CONF-780823—8) **Techniques of preparation and crystal chemistry of transuranic chalcogenides and pnictides.** Damien, D.A.; Haire, R.G.; Peterson, J.R. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1978. Contract W-7405-ENG-26;EY-76-S-05-4447. 19p. Dep. NTIS, PC A02/MF A01.

From Conference on the electronic structure of the actinides; Grenoble, France (30 Aug 1978).

The crystal chemistry of a number of transuranic chalcogenides and pnictides has been investigated using ^{243}Am, ^{248}Cm, ^{249}Bk, and ^{249}Cf. These compounds were prepared from the corresponding metals by direct reaction with the chalcogen or pnictogen element at elevated temperatures. Higher chalcogenides were thermally dissociated to yield ones of lower stoichiometry, terminating with the sesquichalcogenides; only monopnictides of these transplutonium elements were found. All products were examined by x-ray powder diffraction. In this paper the methods for preparing the actinide chalcogenides and pnictides on a gram scale are reviewed, and the microtechniques used for submilligram quantities of the transamericium elements are presented. The results obtained during this study are compared to data previously reported for the lighter actinide compounds, and the trends observed across the series are discussed.

6379 (ORNL—5383, pp 51-53) **Actinide oxides, nitrides, and carbides.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

Calculations indicate that plutonium significantly segregates to the sesquicarbide in almost all cases in the system (U,Pu)C/sub 1-y/O/sub y/ + (U,Pu)$C_{1.5}$. The free energy of formation of UN_s was determined to be 97.53 T—2.960 x 10^5 J/mole from 1125 to 1325°K. Thermodynamic calculations of the fuel-clad interface for the thorium carbides with seven Cr—Fe—Ni alloys show that the solid solutions $ThNi_5$, $ThFe_5$, Cr_7C_3, and Fe_7C_3 were the principal reaction products and that type 316 ss showed the least amount of reaction. (DLC)

6380 (ORNL/TM—6521) **Search for alternate holding reductants to stabilize plutonium (III) solutions.** Kelmers, A.D.; Valentine, D.Y. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 41p. AT.

Kinetic methods were employed to screen reductants for potential application as "holding reductants" for the stabilization of plutonium(III) in nitric acid from reductant-nitrous acid mixtures in nitric acid. Hydrazine, currently employed as a holding reductant, appeared to more rapidly eliminate nitrous acid than other compounds tested. Several sulfur-containing compounds (sulfamic acid, thiourea snd cysteine) gave reaction rates rapid enough to be considered potential holding reductants. Ascorbic acid yielded an intermediate reaction rate and may be applicable as a holding reductant while hydroxylamine and urea gave slow reaction rates. Hydroxylamine is known not to be a suitable holding reductant. It was concluded that hydrazine remains the best candidate holding reductant, although potential problems associated with the formation of hydrazoic acid and metal azides may need further analysis prior to large-scale utilization of hydrazine in fuel reprocessing plants. Potential problems associated with the sulfur-containing compounds are discussed. Additional experimental work with plutonium(III) solutions would be required to further evaluate these potential alternate holding reductants.

6381 (ORO—4447-075) **Preparation, characterization, and decay of einsteinium(II) in the solid state.** Peterson, J.R.; Ensor, D.D.; Fellows, R.L.; Haire, R.G.; Young, J.P. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 7p. (CONF-780823—3). Dep. NTIS, PC A02/MF A01.

From Conference on the electronic structure of the actinides; Grenoble, France (30 Aug 1978).

Samples of $EsCl_2$, $EsBr_2$, and EsI_2 have been prepared for the first time by reduction of the corresponding einsteinium trihalides with hydrogen gas at elevated temperatures. The three dihalides were characterized primarily by their absorption spectra. The products of the decay of EsX_2 samples held at ambient and liquid helium temperatures have been monitored by spectrophotometry. In all cases positive identification of the granddaughter, CfX_2, species has been made. No definite spectral evidence for the presence of the possible daughter products, BkX_2, has been obtained.

6382 Stereochemical course of the high-energy chlorine-38-for-chlorine substitution in cis/trans-1,2-dichlorohexafluorocyclobutanes in solutions. Acciani, T.R.; Ache, H.J. (Virginia Polytechnic Inst. and State Univ., Blackburg). *J. Phys. Chem.;* **82**: No. 13, 1465-1468(29 Jun 1978).

The stereochemistry of the high-energy chlorine-38-for-chlorine substitution process was studied in the cis/trans isomers of 1,2-dichlorohexafluorocyclobutanes. The experimental results indicate that the substitution occurs mostly under retention (>81%) in the presence of hydrogen containing solvents, while in the neat systems and in n-perfluoroheptane solution the yields of inverted product drastically increase. The results are explained in terms of a modified solvent-solute interaction model, which also considers the possible interaction of the reactive molecules making up the solvent environment with the reacting intermediates forming the substituted products. Alternatively the observed results could be interpreted by assuming a solvent effect on the energy distribution of the reacting ^{38}Cl, resulting in changes in the relative importance of the reaction channels leading to substitution via retention and inversion, respectively.

COMBUSTION CHEMISTRY

REFER ALSO TO CITATION(S) 5055, 5137, 5404, 5405, 5431

6383 (CONF-7710136—, pp 56-63) **Stability of premixed H_2/O_2/N_2 combusting turbulent jets.** Nelson, H.F. (Univ. of Missouri, Rolla). 1977.

From 4. UMR-DNR conference on energy; Rolla, MO, USA (11 Oct 1977).

In Proceedings of the fourth annual UMR-DNR conference on energy.

Experimental measurements and theoretical predictions of the stability of hydrogen-air-nitrogen premixed turbulent flames have been carried out. The turbulent flame is theoretically modeled using finite rate chemical kinetics and a well-stirred reactor. The model contains a free parameter, which is evaluated by comparing the theoretical predictions to experimental results. A hydrogen flame stability experiment was carried out and the results were compared to the theory. The theory and experiment were found to agree, if the free parameter in the theory varied as the reciprocal of the turbulent jet radius squared.

6384 (EPA—600/7-77-073d) **Proceedings of the second stationary source combustion symposium. Volume IV. Fundamental combustion research.** Bowen, J.S.; Hall, R.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab.). Jul 1977. 352p. (CONF-770885—P4). NTIS.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

The proceedings document the 50 presentations made during the Second Stationary Source Combustion Symposium held in New Orleans, LA, August 29—September 1, 1977. Sponsored by the Combustion Research Branch of EPA's Industrial Environmental Research Laboratory—RTP, the symposium dealt with subjects relating both to developing improved combustion technology for the reduction of air pollutant emissions from stationary sources, and to improving equipment efficiency. The symposium was divided into

six parts, and the proceedings were issued in five volumes: Volume I—Small Industrial, Commercial, and Residential Systems; Volume II—Utility and Large Industrial Boilers; Volume III—Stationary Engine, Industrial Process Combustion Systems, and Advanced Processes; Volume IV—Fundamental Combustion Research; and Volume V—Addendum. The symposium was intended to provide contractor, industrial, and government representatives with the latest information on EPA inhouse and contract combustion research projects related to pollution control, with emphasis on reducing nitrogen oxides while controlling other emissions and improving efficiency. Ten papers from Vol. IV have been entered individually into EDB and ERA.

6385 (EPA—600/7-77-073d, pp 101-137) **Interactions between sulfur oxides and nitrogen oxides in combustion processes.** Wendt, J.O.L.; Corley, T.L.; Morcomb, J.T. (Univ. of Arizona, Tucson). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

Turbulent diffusion flame studies on gas and oil show that the presence of fuel sulfur could either inhibit, enhance or have no effect both thermal and fuel NO/sub x/, depending on flame aerodynamics and air preheat. Laboratory flat flames studies showed that under fuel rich conditions, the presence of fuel sulfur could have a radical effect on fuel NO formation mechanisms. Both enhancement and apparent inhibition of fuel NO were observed, depending on the stoichiometric ratio, and the residence time at which the measurement was made. The results can be interpreted in the light of current theories on fuel NO formation mechanisms.

6386 (EPA—600/7-77-073d, pp 183-207) **Formation of soot and polycyclic aromatic hydrocarbons in combustion systems. Development of a molecular beam mass spectrometer.** Bittner, J.D. (Massachusetts Inst. of Tech., Cambridge). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

The overall objective of this research program has been to study the production of soot and polycyclic aromatic hydrocarbons (PCAH) in combustion systems. The program has two phases. In one phase the production of soot and PCAH in a turbulent diffusion flame was studied. The results have been reported elsewhere. In the phase discussed in this paper, a low pressure flat laminar premixed flame was used to study the kinetic relationships between soot, PCAH and other hydrocarbon species that may be important as soot nuclei or surface growth species. The molecular beam-mass spectrometer system developed to study the gas phase species is described. Preliminary mass spectral data on an acetylene-oxygen flame are reported.

6387 (EPA—600/7-77-073d, pp 209-234) **Investigation of NO/sub x/, nitrate and sulfate production in laboratory flames.** Seery, D.J.; Zabielski, M.F.; Dodge, L.G. (United Technologies Research Center, East Hartford, CT). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

This research program is directed toward an understanding of the chemical kinetics of the formation of NO/sub x/, nitrates and sulfates in laboratory flames. In the first year, efforts will be directed toward elucidating the mechanisms of "prompt" NO formation and NO—NO_2 conversion. As part of the NO—NO_2 conversion study an investigation will be made of the possible perturbation of the NO_2 concentration by chemical reactions in the sampling probes. The experimental procedure consists of measurements of temperature and composition profiles obtained on a low pressure, flat flame burner and subsequent analysis of these data in terms of chemical mechanisms. Temperature profiles are obtained using miniature thermocouples and gas samples are extracted from the flame for concentration analysis using both a molecular beam sampler and quartz microprobes. The samples extracted by the microprobes will be analyzed by mass spectrometer and chemiluminescent analysis (for NO and NO/sub x/). The molecular beam sampler is combined with a TOF mass spectrometer for analysis of both stable and unstable species. Molecular beam sampling has been selected as a standard for comparison with the microprobe since this technique seemed the one most likely to provide an unperturbed sample of flame gases. In addition to probe sampling, measurements of NO and OH are being carried out using optical spectroscopy in order to provide an independent check on the accuracy of the concentration measurements of these species.

6388 (EPA—600/7-77-073d, pp 235-282) **Influence of aerodynamic phenomena on pollutant formation in combustion. Phase II: liquid fuels.** Spadaccini, L.J.; McVey, J.B.; Kennedy, J.B.; Owen, F.K.; Bowman, C.T.; Vranos, A.; Kesten, A.S. (United Technologies Research Center, East Hartford, CT). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

An experimental investigation of the effects of the interaction between physical and chemical processes on pollutant formation and destruction in a liquid fuel turbulent diffusion flame burner has been carried out. In this investigation, the effects of fuel type, inlet air swirl, inlet air temperature and combustor pressure on the spray characteristics and the time-mean and fluctuating flow field structure have been determined using probing and optical techniques. Changes in the spray and flow field structure have been correlated with changes in pollutant emissions from the burner. The results of this investigation show that variation of these operating parameters produce major changes in spray dynamics and vaporization rates and in the time-averaged fuel/air distribution within the burner which significantly influence energy release rates and pollutant formation and destruction. In addition, it was found that there are significant differences between the mean velocities of the gas and fuel droplets which likely influence droplet vaporization rates and mixing of the vaporized fuel and air.

6389 (EPA—600/7-77-073d, pp 283-310) **Two-dimensional or axially symmetric modeling of combusting flow.** McDonald, H. (Scientific Research Associates, Glastonbury, CT); Buggeln, R.C. Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume IV.

A numerical technique has been developed to solve the time-averaged turbulent reacting flow equations in general two-dimensional orthogonal coordinate systems, including the effects of flow recirculation. The numerical procedure utilizes an efficient robust relaxation scheme which solves a finite difference representation of the coupled set of elliptic partial differential equations of conservation of mass, momentum and energy. Physical models representing the effects of turbulent transport, liquid droplets and radiative heat transfer are incorporated into the scheme. To date the main emphasis of this work has been on obtaining numerical results as free as possible from numerical inaccuracies and truncation error, then comparing the experimental results from a methane burner with theoretical predictions. The predictions were made using three versions of two-equation models of turbulence. Results of comparison show good qualitative agreement between the theory and experimental results in regards to the basic flow patterns. For the swirl number equal 0.3 an experimentally observed toroidally shaped recirculation zone was predicted. When the flow passed round the recirculation zone the swirl velocity rapidly accelerated and downstream the swirl velocity profiles filled out and flattened appreciably as was observed experimentally. In addition the theoretical axial velocity profiles exhibited the observed local maximum at the centerline. Quantitatively the predicted axial velocity profiles compare favorably with the experimental data; however, although in qualitative agreement, the comparison of the swirl velocity profiles does not fare quite as well quantitatively. The principle discrepancies in the flow predictions are thought to be mainly due to the difference in the axial location of the theoretically predicted and the measured location of the toroidal recirculation zone.

6390 (SAND—78-8251) **Periscopes for distributing laser beams.** Smith, J.R. (Sandia Labs., Albuquerque, NM (USA)). Sep 1978. Contract EY-76-C-04-0789. 33p. Dep. NTIS, PC A03/MF A01.

A set of prototype periscopes for distributing laser beams in the Combustion Research Facility has been constructed and tested. Design considerations for maximizing energy transmission and pointing stability are discussed. An analysis of the stability tests done with the prototype periscopes indicates feasibility for this technique in the Combustion Facility. Pointing stability is better than 10 microradians over a wide range of vibrational frequencies and energy throughput of 94%. The impact of this variation on typical optical scattering experiments is discussed. Recommendations are made for implementing the actual periscope system in the Combustion Facility.

ENGINEERING

REFER ALSO TO CITATION(S) 5996

GENERAL ENGINEERING

REFER ALSO TO CITATION(S) 4944

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 6007, 6142

6391 (CONF-771203—, pp 213-215) **Experimental study of a heat pipe with active porous medium.** Spyridonos, A.V. (Democritos Nuclear Research Center, Attikis, Greece). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6392 (CONF-771203—, pp 753) **Extended area ceramic heat exchanger.** Clyde R.A. (Clyde Engineering Service, South Miami, FL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6393 (CONF-771203—, pp 819-821) **Electrical augmentation of spray evaporators.** Spivey, E.C.; Crane, R.A.; Kranc, S.C. (Univ. of South Florida, Tampa). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6394 (LA—7380-PR) **Aerosol research and development related to health hazard analysis. Progress report, July 1, 1976—June 30, 1977.** Fairchild, C.I.; Ortiz, L.W.; Tillery, M.I.; Ettinger, H.J. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 43p. Dep. NTIS, PC A03/MF A01.

The evaluation of virtual impaction as a size separation technique to be used in a rapid size distribution sampler was completed. One low flow rate and one high flow rate virtual impactor (VI) were tested for collection efficiency and wall loss against monodisperse aerosols. Several collection probe (virtual impaction surface) designs, including one unique design using an independent recycling flow, were tested in the low flow VI. This VI was found to have large wall losses. The high flow rate VI exhibited good size separation and low wall losses. Another method of size analysis called the indirect analysis of standard impactors was evaluated. A modified Mercer impactor was used to measure the mass of aerosol passing each stage rather than retained on each stage. The size distribution was comparable to that obtained by conventional impactor analysis. A variable stage impactor designed to pass aerosol penetrating each stage to a rapid mass analysis instrument is being constructed. In this impactor size distribution will be obtained by the analysis of the aerosol fraction penetrating each stage.

6395 (LA-UR—78-2171) **Development and implementation of computer assistance for cost estimating.** Orr, H.D.; Spooner, J.E.; Stutz, R.A. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 8p. (CONF-781032—1). Dep. NTIS, PC A02/MF A01.

From 5. cost engineering congress; Utrecht, Netherlands (30 Oct 1978).

The development of the LACCE, the Los Alamos computerized cost estimating system, is described. During the life of this development, complexity has oscillated back and forth between bare necessity and luxurious wants. As presently structured, LACCE offers the user a power that has been proven beneficial in LASL operations. The complexity involved has been well masked and exists largely on the computer side so that the user is comfortably unaware. The atmosphere of the environment during this development should be noted as highly significant in the success. Management, estimators and systems designers have worked side-by-side; management interest in the success of the venture was understood by all; and skills and expertise overlapped to form a chain with no missing links. It is apparent that LACCE is not complete. More powerful means of modeling and data base maintenance are foreseen already, as well as code simplification, but the existing system gives LASL managers the ability to make much better decisions than just a few years ago.

6396 (SAND—78-1510) **Sandia Laboratories participation in the Avefria experiments.** Krein, T.P.; Niper, E.D.; Smelser, J.H.; Post, H.N. (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 61p. Dep. NTIS, MF A01.

Portions of document are illegible.

Sandia designed a 12-inch diameter payload for the Nike Tomahawk booster system to carry a LASL barium injection experiment. The payload included a telemetry system for monitoring payload performance, an attitude control system to aim the injection perpendicular to the magnetic field lines and a command system to permit ground control of on-board payload functions. Sandia also provided necessary support to field the experiment at their Tonopah Test Range. The work was primarily concerned with the carrier vehicles and fielding operations, and only general statements are made concerning the experiments themselves. LASL has published descriptions of the experiments and will publish the results independently. Appendix A contains a Sandia Statement of Work describing its involvement, and a "Description and Status Report."

6397 (UCID—17919) **Guide for machine tool task force members.** Sutton, G.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1978. Contract W-7405-ENG-48. 41p. Dep. NTIS, PC A03/MF A01.

The purpose of the guide is to assist members of the Machine Tool Task Force (MTTF) in doing the job, preparing technical summary papers, and helping to achieve a uniform, high-quality output from this comprehensive study effort. It supplements the MTTF Plan (UCRL-52552) which contains other important information on the method of operation of MTTF that is related to the preparation of MTTF reports.

6398 (UCRL—81526) **Precision machining commercialization.** Pearson, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1978. Contract W-7405-ENG-48. 8p. (CONF-780829—4). Dep. NTIS, PC A02/MF A01.

From 22. symposium and instrument display; San Diego, CA, USA (28 Aug 1978).

The potential for large DOD cost savings by fabricating optical parts using state-of-the-art precision turning techniques has resulted in an Air Force Materials Laboratory program to commercialize the technology, now largely within DOE contractor laboratories and production facilities. Machining process is becoming an extension of optical process requiring a melding of optical and machining disciplines, including cost trade off for part complexity and production volume. Differences in terminology and specification conventions are being resolved. The goal of the three-year commercialization program is to accelerate a technology diffusion process faster than is likely to be realized by market forces so as to capture potential fabrication savings for presently identified needs. The program will sponsor seminars and workshops, aid in procurement specification writing, provide shop floor assistance in tool performance testing and supply documentation of the technology for individual reference. Program plans call for a partnership with selected industrial companies in commercializing state-of-the-art precision turning technology.

6399 **Heat pipe assembly.** Anderson, J.H.; Waters, E.D. (to McDonnell Douglas Corp.). US Patent 4,090,555. 23 May 1978. Filed date 15 Apr 1977. 16p.

A separable heat pipe assembly is described for stabilizing the generally frozen soil adjacent and supporting a structural member or foundation in permafrost or similar regions, including a cooperative combination of a tubular structure installed in a permafrost environment, a heat pipe element having its lower portion installed in the structure and positioned at least in proximity longitudinally to the wall of the structure, and soil or other substance filling the space remaining between the lower element portion and the structure wall. The upper portion of the heat pipe element has a thicker wall than its lower portion and can be provided with threads thereon. A sleeve-type radiator can be provided with complementary threads therein so that the radiator can be threadedly engaged to the upper element portion. The depth and pitch of the threads can be changed to vary the heat transfer surface area obtainable between the engaged radiator and upper element portion. Alternatively, the radiator and upper element portion are not threaded but can be sized to provide for an interference press fit to secure them together. A lubricant-preservative-thermal substance can be used to fill any interface space between the mating surfaces of the threadedly engaged or press-fitted radiator and upper element portion.

6400 **Omega-X micromachining system.** Miller, D.M. (to United States Dept. of Energy). US Patent 4,083,272. 11 Apr 1978. Filed date 14 Dec 1976. 28p.

PAT-APPL-750,317.

A micromachining tool system with X- and omega-axes is used to machine spherical, aspherical, and irregular surfaces with a maximum contour error of 100 nonometers (nm) and surface waviness of no more than 0.8 nm RMS. The omega axis, named for the angular measurement of the rotation of an eccentric mechanism supporting one end of a tool bar, enables the pulse increments of the

tool toward the workpiece to be as little as 0 to 4.4 nm. A dedicated computer coordinates motion in the two axes to produce the workpiece contour. Inertia is reduced by reducing the mass pulsed toward the workpiece to about one-fifth of its former value. The tool system includes calibration instruments to calibrate the micromachining tool system. Backlash is reduced and flexing decreased by using a rotary table and servomotor to pulse the tool in the omega-axis instead of a ball screw mechanism. A thermally-stabilized spindle roates the workpiece and is driven by a motor not mounted on the micromachining tool base through a torque-smoothing pulley and vibrationless rotary coupling. Abbe offset errors are almost eliminated by tool setting and calibration at spindle center height. Tool contour and workpiece contour are gaged on the machine; this enables the source of machining errors to be determined more readily, because the workpiece is gaged before its shape can be changed by removal from the machine.

6401 Holder for rotating glass body. Kolleck, F.W. (to United States Dept. of Energy). US Patent 4,082,531. 4 Apr 1978. Filed date 24 Jan 1977. 4p.

PAT-APPL-762,226.

A device is provided for holding and centering a rotating glass body such as a rod or tube. The device includes a tubular tip holder which may be held in a lathe chuck. The device can utilize a variety of centering tips each adapted for a particular configuration, such as a glass O-ring joint or semi-ball joint.

6402 Solids irradiator. Whitefield, W.J.; Pierce, J.D.; Morris, M.E. (to Dept. of Energy). US Patent Application 844,085. 20 Oct 1977. 14p.

A novel facility is described for irradiation of solids embodying pathogens wherein solids are conveyed through an irradiation chamber in individual containers of an endless conveyor.

6403 Interferometric correction system for a numerically controlled machine. Burleson, R.R. (to Dept. of Energy). US Patent Application 841,087. 11 Oct 1977. 12p.

An interferometric correction system for a numerically controlled machine is provided to improve the positioning accuracy of a machine tool, for example, for a high-precision numerically controlled machine. A laser interferometer feedback system is used to monitor the positioning of the machine tool which is being moved by command pulses to a positioning system to position the tool. The correction system compares the commanded position as indicated by a command pulse train applied to the positioning system with the actual position of the tool as monitored by the laser interferometer. If the tool position lags the commanded position by a preselected error, additional pulses are added to the pulse train applied to the positioning system to advance the tool closer to the commanded position, thereby reducing the lag error. If the actual tool position is leading in comparison to the commanded position, pulses are deleted from the pulse train where the advance error exceeds the preselected error magnitude to correct the position error of the tool relative to the commanded position.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 6256, 7098, 7119

6404 (LA—7428-MS) Program NICOLET to integrate energy loss in superconducting coils. Vogel, H.F. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

A voltage pickup coil, inductively coupled to the magnetic field of the superconducting coil under test, is connected so its output may be compared with the terminal voltage of the coil under test. The integrated voltage difference is indicative of the resistive volt-seconds. When multiplied with the main coil current, the volt-seconds yield the loss. In other words, a hysteresis loop is obtained if the integrated voltage difference phi = $\int \Delta V dt$ is plotted as a function of the coil current, i. First, time functions of the two signals phi(t) and i(t) are recorded on a dual-trace digital oscilloscope, and these signals are then recorded on magnetic tape. On a CDC-6600, the recorded information is decoded and plotted, and the hysteresis loops are integrated by the set of FORTRAN programs NICOLET described in this report. 4 figures.

6405 (LBL—7931) Vacuum impregnation with epoxy of large superconducting magnet structures. Green, M.A.; Coyle, D.E.; Miller, P.B.; Wenzel, W.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 16p. (CONF-780751—1). Dep. NTIS, PC A02/MF A01.

From Cryogenic materials conference; Munich, F.R. Germany (10 Jul 1978).

The Lawrence Berkeley Laboratory (LBL) has been developing a new generation of superconducting magnets which have the helium cooling system as an integral part of the magnet structure. The LBL technique calls for large sections of the magnet structure to be vacuum impregnated with epoxy. The epoxy was chosen for its impregnation properties. Epoxies which have good impregnation characteristics are often subject to cracking when they are cooled to cryogenic temperatures. The cracking of such an epoxy can be controlled by: (1) minimizing the amount of epoxy in the structure; (2) reducing the size of unfilled epoxy spaces; and (3) keeping the epoxy in compression. The technique for using the epoxy is often more important than the formulation of the epoxy. The LBL vacuum impregnation and curing technique is described. Experimental measurements on small samples of coil sections are presented. Practical experience with large vacuum impregnation superconducting coils (up to two meters in dia) is also discussed.

6406 (LBL—8019) Superconducting transition edge bolometer and noise in thin films. Yeh, N.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 112p. Dep. NTIS, PC A06/MF A01.

Thesis.

The development of the composite superconducting transition edge bolometer is reported. The temperature sensitive element is an aluminum strip evaporated onto the sapphire substrate. A bismuth film evaporated on the reverse side of the substrate is used to absorb the submillimeter radiation. The noise limitation of the bolometer is calculated. The fabrication and measured performance are described. The best electrical NEP (noise-equivalent-power) obtained is (1.7 +- 0.1) x 10^{-15} $WHz^{-1/2}$ at 2 Hz at an operating temperature of 1.27 K. This NEP is within a factor of 2 of the thermal noise limit. The effective absorptivity of the bismuth film is measured to be 0.47 +- 0.05, and the corresponding detectivity D^* is calculated to be (1.1 +- 0.1) x 10^{14} cm W^{-1} $Hz^{1/2}$. Suggestions are made for further improvements in sensitivity. The current-dependent noise in thin metal films at the superconducting transition has been further investigated. The measured noise power spectrum of the tin film on sapphire substrate at the superconducting transition is compared with the cosine transforms of the decay curves obtained from step-function and delta-function thermal perturbations. The nature of the noise driving term is found to be a random current flowing inside the sample, in agreement with the uncorrelated thermal fluctuation model. This result is consistent with the case of a freely suspended tin fiber at the superconducting transition, but in contrast to the room temperature measurement where the cosine transform of the step-function response gives the noise power spectrum, in agreement with the correlated fluctuation model.

6407 (LBL—8030) Noise limitations of the DC SQUID. Clarke, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1978. Contract W-7405-ENG-48. 8p. (CONF-780349—2). Dep. NTIS, PC A02/MF A01.

From 5. conference on noise in physical systems; Bad Nauheim, F.R. Germany (13 Mar 1978).

The dc SQUID (Superconducting Quantum Interference Device) is a very sensitive detector of changes in magnetic flux, and is becoming widely used as a magnetometer and as a voltmeter. The paper summarizes the noise limitations of the device and makes projections of its ultimate performance. A more detailed account of the work is to appear elsewhere.

6408 Superconducting hybrid magnetic flux pump. Rabinowitz, M.; Rodenbaugh, T.J. (to Electric Power Research Inst., Inc.). US Patent 4,096,403. 20 Jun 1978. Filed date 28 Jun 1976. 12p.

A flux pump is described that has a closed superconducting circuit including wire of relatively high critical field and a gate defining a current-carrying path through a coil, the latter being moveable relative to a magnetic field source to cause normal conduction of current in a plurality of gate modules of a relatively low critical field in the circuit at spaced locations along the same. Thus, a flux pumping action occurs in the coil as the modules are subjected to the field of the source. The modules are separated from each other by strips of insulation material and the wire, connected to opposite ends of the gates, passes through adjacent insulation strips in a manner such that the current flow in the circuit is always in the same direction. The speed of the flux pumping action can be increased by having several groups of modules arranged in parallel with each other and excited simultaneously with a number of modules in each group being in series with each other. A plurality of gates properly connected within a module also increases the rate of excitation of de-excitation of the flux pump.

6409 Sliding support for a superconducting generator rotor. Ying, S.C.; Cooper, G.D. (to Electric Power Research Inst.). US Patent 4,092,555. 30 May 1978. Filed date 15 Oct 1976. 12p.

In a superconducting generator rotor, inner and outer rotor structures are rigidly connected against torsional and axial relative movement at one end of the rotor. At the opposite end of the rotor a sliding support permits relative axial movement of the inner rotor relative to the outer rotor during cool down. The sliding support connection of the inner rotor to the rotating outer rotor and stub

shaft of the generator power train is closed by a flexible diaphragm which has protruding axially therefrom a plurality of integrally attached fingers. These fingers, at an outside radial surface, bear into a complementary cylindrical cavity in the end of the stub shaft having female spline receiving concavities. During thermal axial excursion incident to cool down, the fingers by sliding into and out of the spline concavities in the stub shaft accommodate relative axial movement of the inner rotor relative to the outer rotor. During on-line operation of the rotor, the fingers maintain a positive and nonsliding fit with the stub shaft so that by positive outward pressure at the fingers, slip and fretting corrosion of the fingers and stub shaft is prevented.

6410 Rotating superconductor magnet for producing rotating lobed magnetic field lines. Hilal, S.K.; Sampson, W.B.; Leonard, E.F. (to United States Dept. of Energy). US Patent 4,084,209. 11 Apr 1978. Filed date 21 May 1976. 6p.

PAT-APPL-688,873.

A rotating superconductor magnet is described for producing a rotating lobed magnetic field, comprising a cryostat; a superconducting magnet in the cryostat having a collar for producing a lobed magnetic field having oppositely directed adjacent field lines; rotatable support means for selectively rotating the superconductor magnet; and means for energizing the superconductor magnet.

PROTECTIVE STRUCTURES AND EQUIPMENT

6411 (ORNL/TM—6400) **Minimum acceptable face velocities of laboratory fume hoods and guidelines for their classification.** Bolton, N.E.; Porter, W.E.; Alcorn, S.P.; Everett, W.S.; Hunt, J.B.; Morehead, J.F.; Higdon, H.F. (Oak Ridge National Lab., TN (USA)). Jun 1978. Contract W-7405-ENG-26. 37p. Dep. NTIS, PC A03/MF A01.

Data developed to support the requirement of a 100 LFM minimum face velocity requirement for laboratory fume hoods are summarized. Also included is a description of the Y-12 test hood as well as guidelines for a hood classification scheme.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 5309, 5852

6412 (HEDL-TME—78-53) **Spent Fuel Handling and Packaging Program: a survey of hot cell facilities.** Menon, M.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1978. Contract EY-76-C-14-2170. 29p. Dep. NTIS, PC A03/MF A01.

Hot cell facilities in the United States were surveyed to determine their capabilities for conducting integral fuel assembly and individual fuel rod examinations that are required in support of the Spent Fuel Handling and Packaging Program. The ability to receive, handle, disassemble and reconstitute full-length light water reactor spent fuel assemblies, and the ability to conduct nondestructive and destructive examinations on full-length fuel rods were of particular interest. Three DOE-supported facilities and three commercial facilities were included in the survey. This report provides a summary of the findings.

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 5313, 5314

6413 (BNWL-SA—6313) **Effective neutron isolation thickness values obtained from reflector savings data.** Howes, B.W.; Bierman, S.R.; Clayton, E.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1977. Contract EY-76-C-06-1830. 32p. (CONF-770611—40). Dep. NTIS, PC A03/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

The accurate determination of minimum material thicknesses required for isolating multiplying media from neutron interaction is a problem of considerable interest in the design of shipping containers and storage vaults. The net amount of storage space required for nuclear materials can be effectively reduced and criticality controls, improved through the proper use of neutron-absorbing and -moderating materials near the fuel boundary. A series of critical approach experiments was conducted at the Battelle-Northwest Critical Mass Laboratory utilizing a split-table machine in order to measure effective isolation thickness values for several materials. Analytical methods were developed for investigating the effect of fuel geometry and material compositions upon the experimental results. As a result of the data analysis, a simplified experimental technique was developed for determining isolation thickness values from the reflector savings data. Also, it was determined that many of the currently acceptable isolation thickness values are low by at least a factor of two. It was found that the minimum isolation thickness values vary significantly with the cross-sectional area of the fuel system. Diffusion theory calculations indicated that the thickness of material necessary for isolating two critical fuel slabs of essentially infinite cross-sectional dimensions was approximately a factor of four greater than that required for the experimental system. Also, it was found that the minimum isolation thickness value of concrete varies significantly with the hydrogen concentration. 12 figures, 4 tables.

6414 (SAND—78-0228C) **Effect of fission gas leakage on heat transfer within a helium filled spent fuel shipping cask.** Pope, R.B.; Schimmel, W.P. Jr. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 5p. (CONF-780622—20). Dep. NTIS, MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Portions of document are illegible.

Leakage of Xe from spent fuel elements into a He-filled cask would reduce the thermal conductivity, but it would also increase the nondimensional Grashof and Rayleigh number convection parameters. The thermal performance for various quantities of leaked fission gases was evaluated for a cask containing 9 fuel assemblies, each producing approximately 2 kW, and a He partial pressure of 4 atm. If all pins leaked, the max pin temperature would increase from 761 to 839°K. It is concluded that the effect of fission gases is a second order effect. (DLC)

TRANSPORT AND STORAGE FACILITIES

6415 Capacitance measurement of solids in pipeline transport. Keska, J. *Arch. Gorn.;* **21**: No. 1, 19-36(1976). (In German).

A capacitance method for measurement of solids in pipeline flow has been developed. Tests were carried out using sand-water mixtures and the results are shown. Details are given of the test rig and the measuring head. Coal industry applications envisaged are in hydraulic stowing, hydro-mechanical winning and coal preparation.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 6229

6416 Raise bore drilling. French, G.B. (to Occidental Oil Shale, Inc.). US Patent 4,095,656. 20 Jun 1978. Filed date 3 Mar 1976. 20p.

In raise bore drilling, a drill string of non-round cross-sectional configuration is connected through a pilot hole from a raise bore bit at the lower end of the pilot hole to a raise bore drilling rig at the upper end of the hole. The drill string is defined by a number of serially connected individual pipe lengths. The drill string configuration preferably is hexagonal except at one end of each length where the pipe length is round for a distance which corresponds to the length of a female threaded connection component defined by that end of the pipe length. The other end of each pipe length defines a cooperating male threaded connection component.

6417 Speed of penetration. Gosselin, J.C. pp 15p, Paper 1 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From Conference on the problems of radioactive wastes in nuclear technology; Essen, F.R. Germany (20 Oct 1977).

The possibility of measuring the instantaneous penetration speed V/sub p/ with sufficient accuracy that it can be used in drill off tests was proven. The use of this test makes it possible to optimize the compromise between penetration rate and bit wear and to monitor the performance of a bit. (JSR)

6418 Simalog gives the formation porosity while you drill as well as correlations from well to well. Belloti, P.; Giacca, D.; Santalmasi, B. (AGIP, Milan). pp 22p, Paper 3 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977).

From Conference on the problems of radioactive wastes in nuclear technology; Essen, F.R. Germany (20 Oct 1977).

The sigmalog is a new approach to detect abnormal formation pressure and for the immediate calculation of pore pressure gradients from drilling parameters. The possibilities resulting from the use of the sigmalog in the field are described and illustrated. The interpretation criteria and the advantages and disadvantages of the method are discussed. The theory is summarized. (JSR)

6419 Mechanical logs: estimation of formation pressure and porosity during drilling. Gerard, R.E. pp 12p, Paper 2 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From Conference on the problems of radioactive wastes in nuclear technology; Essen, F.R. Germany (20 Oct 1977).

Mechanical logs are those logs using the drilling parameters to determine formation properties. The mechanical logs described are the d-exponent, the sigmalog, and the logs derived from the

Combs equations. The d-exponent correlates the drilling rate parameters with the differential pressure between the drilling fluid and the formation water. In the sigmalog the drilling parameters are correlated with the mechanical resistance of the rock drilled. Combs equations correlate the pore pressure gradient and the drilling parameters. (JSR)

LASERS

REFER ALSO TO CITATION(S) 6390, 6872

6420 (COO—2007-97) **Advanced methods for nuclear reactor gas laser coupling.** Miley, G.H.; Verdeyen, J.T. (Illinois Univ., Urbana (USA). Dept. of Nuclear Engineering). Jun 1978. Contract EY-76-S-02-2007. 51p. Dep. NTIS, MF A01.

Portions of document are illegible.

Research is described that led to the discovery of three nuclear-pumped lasers (NPLs) using mixtures of Ne—N_2, He—Hg, and He or Ne with CO or CO_2. The Ne—N_2 NPL was the first laser obtained with modest neutron fluxes from a TRIGA reactor (vs fast burst reactors used elsewhere in such work), the He—Hg NPL was the first visible nuclear-pumped laser, while the Ne—CO and He—CO_2 lasers are the first to provide energy storage on a millisecond time scale. Important potential applications of NPLs include coupling and power transmission from remote power stations such as nuclear plants in satellites and neutron-feedback operation of inertial confinement fusion plants.

6421 (LA—7331-MS) **Mid-infrared optically pumped lasers.** Jones, C.R. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 20p. Dep. NTIS, PC A02/MF A01.

Optically pumped lasers emitting in the middle-infrared spectral region are reviewed. General features of these lasers are discussed, and published data on them are summarized. Approximate lasing wavelengths are indicated, and a few of the more important mid-infrared optically pumped lasers are treated in more detail.

6422 (LBL—7854) **Stable 1 → 0 carbon monoxide laser.** Gerlach, R.; Amer, N.M. (California Univ., Davis (USA). Dept. of Engineering). Jul 1978. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

A stable carbon monoxide laser capable of oscillation on transitions in the fundamental 1 → 0 band is described. This laser is also capable of a quasi-continuous tunability in the range of 4.7 to 8 microns.

6423 **Gas recirculating stabilized laser.** Foster, J.D. (to Universal Laser Corp.). US Patent 4,099,143. 4 Jul 1978. Filed date 14 Jan 1977. 6p.

A recirculating gas laser includes a gs-containing closed chamber having optically aligned mirrors adjacent the ends with a closed loop gas reciculation path, means for moving the gas around that path, and means for producing an electrical discharge in the gas, generally transversely of the optical axis. A heat exchanger for cooling the gas is interposed in the gas flow path, and means for supporting the mirrors extend longitudinally of the chamber and are positioned within the gas flow path to receive the cooled gases thereagainst, this support means being mounted to the chamber by other means which isolate the support from expansion and contraction of the chamber.

6424 **Lasers.** Hill, R.J.; Price, R.B.; Jewell, N.T. (to Rolls-Royce Ltd.). US Patent 4,097,820. 27 Jun 1978. Priority date 26 Jan 1972, United Kingdom of Great Britain and Northern Ireland (UK). 10p.

A laser resonator is combined with a circuitous detonation channel to which is fed a suitable explosive gas mixture. The gas mixture is ignited, thereby creating traveling detonation waves which are maintained in circulation around the detonation channel. A population inversion is produced in the detonation product by exhausting the products via a convergent-divergent supersonic expansion nozzle. The products then pass through the laser resonator. At least one substantially linear portion is formed in a detonation channel circuit with the supersonic expansion nozzle being formed in this section of the detonation channel. The optical axis of the laser resonator is oriented to be substantially parallel to a slit nozzle which forms the supersonic expansion nozzle to thereby achieve a large ratio of active length to diameter of the laser resonator.

6425 **Semiconductor laser.** Bellavance, D.W. (to Texas Instruments Inc.). US Patent 4,097,819. 27 Jun 1978. Filed date 25 Feb 1977. 6p.

A semiconductor laser is described that has a semiconductor base having (100) orientation. A semiconductor mesa of a III-V material is grown on the base by liquid phase epitaxy. The semiconductor mesa has crystallographic facets perpendicular to the base and parallel to one another. The crystallographic facets form the reflecting mirrors of a lasing cavity.

6426 **Adjustable etalon laser mode selector and method of adjustment.** Manoukian, N.S.; Johnston, T.F. Jr. (to Coherent, Inc.). US Patent 4,097,818. 27 Jun 1978. Filed date 3 Sep 1976. 10p.

An adjustable etalon mode selector is mounted within the optical cavity of a laser and includes a pair of spaced prisms mounted along the optical axis of the cavity with the laser beam passing therethrough and means for selectively adjusting the spacing between the prisms in a manner such that the resonant frequency of the laser cavity and etalon combination remains constant during the adjustment of the prism spacing in order that a particular mode of the operating wavelength spectrum of the laser may be selected for output, without the adjustment modulating the cavity natural resonant frequency.

6427 **Multi-mode threshold laser.** Clow, R.G. US Patent 4,088,964. 9 May 1978. Filed date 15 Apr 1976. 46p.

An image amplifying multi-mode laser with image forming elements in the cavity and with a saturable absorber film at the focal plane in the cavity is described. Radiation from each point of an image is focused on the saturable absorber film so as to enter a distinct mode of the multi-mode laser. Pump power and saturable absorber film density are jointly adjusted so that a mode of the laser oscillates if and only if the intensity of the radiation from the corresponding image point exceeds a given threshold value. The energy emitted from the bistable laser oscillations constitutes the output. The multi-mode threshold laser is useful for image contrast enhancement, applying a threshold operation in optical information processing, selection of the maximum point of optical matched filter output images and as a naturally-formed collection of optical logic elements. Embodiments are disclosed in retro-reflector cavities having both traveling and standing wave modes.

6428 **Charge transfer reaction laser with preionization means.** Lauderslager, J.B.; Pacala, T.J. (to National Aeronautics and Space Administration). US Patent 4,088,965. 9 May 1978. Filed date 12 Jul 1976. 12p.

A helium-nitrogen laser is described in which energy in the visible range is emitted as a result of charge transfer reaction between helium ions and nitrogen molecules. The helium and nitrogen are present in a gas mixture at several atmospheres pressure, with a nitrogen partial pressure on the order of less than one percent. Prior to applying a discharge pulse to the gas mixture at the high pressure by means of a pair of main discharge electrodes, the gas mixture is preionized to prevent arcing when the discharge pulse is applied. The preionization is achieved by the application of a high voltage across a pair of secondary electrodes which are spaced apart in a direction perpendicular to the spacing direction of the main discharge electrodes and the longitudinal axis of the space in which the gas mixture is contained. Feedback, by means of a pair of appropriately spaced mirrors, is provided to produce coherent energy pulses at a selected wavelength.

6429 **CF_4 laser.** Wittig, C.; Tiee, J.J. (to Dept. of Energy). US Patent Application 844,086. 20 Oct 1977. 6p.

A CF_4 laser for producing near 16 μm radiation utilizing a line tunable CO_2 laser as an optical pumping source is described. The device uses a cryogenically cooled optical pumping cavity containing molecular CF_4 gas. An optical resonant cavity formed around the optical pumping cavity induces oscillations of near 16 μm radiation from the $\nu_2 + \nu_4$ yields ν_2 transition in the molecular CF_4 gas.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 5812, 5853, 5896, 5907, 5909, 5913, 5962, 5963, 6391, 6392, 6393

6430 (CONF-771203—, pp 823-829) **Solution for thermal development of flow in an annulus with periodic boundary conditions.** El-Ariny, A.S.; Aziz, A. (Univ. of Riyadh, Saudi Arabia). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6431 (UCRL—13873) **Two dimensional numerical model for steam—water flow in a sudden contraction.** Crowe, C.T.; Choi, H.N. (Washington State Univ., Pullman (USA). Thermal Energy Lab.). 1976. Contract W-7405-ENG-48. 10p. Dep. NTIS, PC A02/MF A01.

A computational model developed for two-dimensional dispersed two-phase flows is applied to steam—water flow in a sudden

contraction. The calculational scheme utilizes the cellular approach in which each cell is regarded as a control volume and the droplets are regarded as sources of mass, momentum and energy to the conveying (steam) phase. The predictions show how droplets channel in the entry region and affect the velocity and pressure distributions along the duct.

6432 Method of measuring the mass flow rate of a substance entering a cocurrent fluid stream. Cochran, H.D. Jr. (to United States Dept. of Energy). US Patent 4,083,243. 11 Apr 1978. Filed date 22 Apr 1977. 4p.

PAT-APPL-789,764.

An improved method of monitoring the mass flow rate of a substance entering a coherent fluid stream is described. The method very basically consists of heating equal sections of the fluid stream above and below the point of entry of the substance to be monitored, and measuring and comparing the resulting change in temperature of the sections. Advantage is taken of the difference in thermal characteristics of the fluid and the substance to be measured to correlate temperature differences in the sections above and below the substance feed point for providing an indication of the mass flow rate of the substance.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 6252, 6479

6433 (LA-UR—78-630) **High energy, cine radiographic experiment.** Bryant, L.E. Jr.; Craig, B.G.; Lundy, A.S.; Morton, W. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-NEG-36. 3p. (CONF-780804—8). Dep. NTIS, PC A02/MF A01.

From 13. congress on high-speed photography and photonics; Tokyo, Japan (20 Aug 1978).

A cine radiographic technique is being developed by using an inert rocket motor to simulate a burning rocket motor. If the development effort progresses to success, it would be possible to radiographically visualize propellant grain burning surfaces and thereby determine velocity of burn as well as to image any abnormal conditions during the burn that would otherwise be obscured by flame, smoke, or the rocket motor case.

6434 (UCRL—81194) **Ultrasonic imaging.** McKinley, B.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 May 1978. Contract W-7405-ENG-48. 10p. (CONF-780650—2). Dep. NTIS, PC A02/MF A01.

From 1. symposium on ultrasonic materials characterization; Gaithersburg, MD, USA (7 Jun 1978).

The ultrasonic imaging project's purpose is to increase resolution and produce accurate graphic ultrasonic images. Sub projects directed at achieving these goals are: (1) mathematical modeling of elastic wave scattering for realistic defects, (2) developing signal analysis techniques to allow thorough quantitative ultrasonic field measurements, (3) design and fabrication of a high precision, versatile, computer controlled two transducer ultrasonic test bed with on line computerized data acquisition, analysis, and image display. Improved methods for quantitative evaluation of bond strength, cracks, and joining are required by current LLL programs. From these requirements the necessity of a two transducer test bed has become evident. This new concept in ultrasonic test beds now under development is described.

6435 Acoustic imaging system. Smith, R.W. (to Dept. of Energy). US Patent Application 843,182. 18 Oct 1977. 20p.

An acoustic imaging system is described for displaying an object viewed by a moving array of transducers as the array is pivoted about a fixed point within a given plane. A plurality of transducers are fixedly positioned and equally spaced within a laterally extending array and operatively directed to transmit and receive acoustic signals along substantially parallel transmission paths. The transducers are sequentially activated along the array to transmit and receive acoustic signals according to a preestablished sequence. Means are provided for generating output voltages for each reception of an acoustic signal, corresponding to the coordinate position of the object viewed as the array is pivoted. Receptions from each of the transducers are presented on the same display at coordinates corresponding to the actual position of the object viewed to form a plane view of the object scanned.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 6472

6436 (SAND—78-0720C) **Die attach quality of multiple cell power transistors.** Meyer, W.J.; Skogmo, D.G. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 4p. (CONF-781107—3). Dep. NTIS, PC A02/MF A01.

From Government microcircuit applications conference; Monterey, CA, USA (14 Nov 1978).

Multiple cell single chip power devices dissipate power at discrete locations across the semiconductor die. Traditional tests of die attach quality, such as thermal resistance and die shear measurements, do not address the power density topology of the die. This paper correlates x-ray photographs of die attach interfaces with acceptable and unacceptable operating device temperature profiles to obtain a more meaningful test of die attach quality.

6437 (SAND—78-0801C) **Transfer molding of flat flexible cable terminations.** Voida, G. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 15p. (CONF-781013—1). Dep. NTIS, MF A01.

From 11. connector symposium; Cherry Hill, NJ, USA (25 Oct 1978).

Portions of document are illegible.

The terminations of cables are normally sealed with either liquid epoxy or polyurethane encapsulating resins. The report describes the use of two different transfer molded powdered epoxy compounds for sealing of flat, flexible cables which were laminated with acrylate adhesive. One of the molding compounds was mineral-filled and the other was glass fiber filled.

6438 (SAND—78-0834) **Development of the SECOM II center-loaded whip antenna.** Hansen, E.L.; Olson, W.D. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 38p. Dep. NTIS, PC A03/MF A01.

Sandia Laboratories has the responsibility to provide engineering support to DOE/ALO for the operational SEcurity COMmunications II (SECOM II) system. As a part of this task, a program was initiated to determine if an improved mobile antenna could be developed. The program and the center-loaded whip antenna that resulted from these efforts are described.

6439 (ORNL-tr—4574) **PCM systems in measurement practice: recording and transmission of analog measurement data.** Glockmann, H.P. Translated by J. Lee from *VFI;* No. 2 and 3, 8(1974). 27p. Dep. NTIS, PC A03/MF A01.

PCM methods have proved very useful in communications engineering and especially for telemetric problems. They are equally suited for more varied applications in measuring practice, and above all they are more efficient and less expensive than FM methods in the area of magnetic tape recording of analog measurement data. In this article some general observations are given, and then the function and application of PCM systems are discussed, with a 32-channel model which has recently been put on the market as an example. 10 figures, 3 tables.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 5133, 5135, 5710, 5723, 5726, 5727, 5730, 5732, 6459, 6461

6440 (EPA—600/7-77-073c, pp 3-47) **Application of combustion modifications to industrial combustion equipment.** Hunter, S.C.; Carter, W.A.; Buening, H.J.; Cherry, S.S. (KVB, Inc., Tustin, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume III.

A research program for evaluating the effectiveness of combustion modifications as means of emissions reduction and thermal efficiency improvement on industrial combustion equipment is reported. A survey conducted to determine important and representative industrial equipment resulted in the selection of combustion devices for tests in the petroleum refining, minerals, paper, and metals industries. Results are presented of tests on petroleum refinery heaters, mineral kilns, metal furnaces, boilers burning unconventional fuels, internal combustion engines, and gas turbine combined cycles. Tests results from two modified industrial boilers are also included. The effects of process variables, excess air reduction, burner adjustments, staged combustion and fuel type were the main techniques evaluated. The results indicated that these techniques, developed primarily on conventional steam boilers, are also effective in emissions control on certain devices but some devices were completely unresponsive. Critical process temperatures, chemistry and fluctuations represent the main constraints and the effectiveness of combustion modifications is primarily dependent on process flexibility.

6441 (EPA—600/7-77-073c, pp 255-278) **Evaluation of a prototype surface combustion furnace.** Martin, G.B. (Environmental Protection Agency, Research Triangle Park, NC). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume III.

The emissions characteristics of a prototype surface combustion residential furnace have been evaluated using both propane and natural gas. The combustion of premixed fuel and air takes place on a refractory surface without a visible flame. Heat is transferred from the surface to an air cooled firebox wall by radiation. This maintains a relatively low surface temperature and reduces the oxides of nitrogen (NO/sub x/). The furnace was operated over a range of excess air from 5 to 45 percent and with heat input from 16,000 to 24,000 watts. For a nominal operating point for natural gas at 10 percent excess air, NO/sub x/ emissions were less than 15 ppM (as measured). CO and HC emissions were also low. Furnace efficiency calculated from flue losses was greater than 80 percent. Performance on propane was similar.

6442 (EPA—600/7-77-073e, pp 7-30) **Effects of fuel and atomization on NO/sub x/ control for heavy liquid fuel-fired package boilers.** Cichanowicz, J.E. (Energy and Environmental Research Corp., Santa Ana, CA); Lobell, M.H.; Heap, M.P.; Pershing, D.W. Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

A program is described which is planned to establish the effect of fuel properties and of fuel atomization parameters on NO/sub x/ control techniques for package boilers fired with heavy liquid fuels. This program consists of three investigations: combustor experiments to assess atomizer and fuel effects; spray characterization under cold and hot flow; and small-scale experiments to be conducted under controlled conditions to evaluate those parameters controlling fuel nitrogen formation in liquid fuel flames. The discussion is restricted to a description of the proposed effort and the rationale leading to the definition of the experimental program. (LCL)

6443 (FE—2463-6) **Industrial application fluidized bed combustion process. Quarterly report, October—December 1976.** (FluiDyne Engineering Corp., Minneapolis, MN (USA)). Jan 1977. Contract EX-76-C-01-2463. 42p. Dep. NTIS, PC A03/MF A01.

In accordance with the Phase I schedule, 18" FBC performance and equipment operation tests with Iowa coal (designated as the primary fuel for the demonstration program) were completed. These tests were followed by additional performance tests with petroleum coke and Tennessee coal (both secondary fuels). Vertical slice test unit design and fabrication activities were also continued. Preliminary design activities were directed to definition of the Owatonna Tool Co. plant heating load, definition of the availability and cost of different types of fuel and sorbent, definition of the type of storage and handling system required for fuel and sorbent, evaluation of reserve fuel requirements and preparation of a preliminary site arrangement. The preliminary heating load calculated is 23.15 x 10^6 Btu/hr compared to 30.8 x 10^6 Btu/hr noted in the proposal. Fuel and sorbent are readily available delivered to OTC within the projected cost. A decision was made to include provision for fuel and sorbent drying in the storage and handling system.

6444 (HCP/T1237—01/1) **Multicell fluidized bed boiler design, construction, and test program. Quarterly progress status report, July—September 1977.** (Pope, Evans and Robbins, Inc., New York (USA)). Jul 1978. Contract EX-76-C-01-1237. 101p. (FE—1237-10). Dep. NTIS, PC A06/MF A01.

Major activities at the Rivesville MFB Plant consisted of the embodiment of many improvements and were culminated by the achievement of the first commercial operation of a fluidized-bed boiler. This event was accomplished on September 16, 1977, when steam produced in the MFB was used for generation of electricity in Monongahela's Turbine Generator No. 5. The range of other accomplishments, together with the development of improved operating procedures was extensive and included many improvements in the boiler. Initiation of the "Charge Bed" light-off technique, operation of all possible combinations of MFB Cells, and proven performance of the bed material drain, classification and storage operations. The installation of additional supportive instrumentation has progressed to the stage where all control loops, except bed height, have now been calibrated and are operable in the automatic mode. All boiler safety valves were set and functioned flawlessly during many tests in a continuous 68 hour coal-fired run. Significant progress was made in solving coal feeding problems and fines obstruction of the feeders with the development of a logic model toward that aim. On August 26, 1977, the MFB was formally dedicated with Senator Robert C. Byrd as the principal speaker at the ceremonies. Other technical activities are described.

6445 (HCP/T1237—01/2) **Multicell fluidized bed boiler design, construction, and test program. Quarterly progress status report, October—December 1977.** (Pope, Evans and Robbins, Inc., New York (USA)). Jul 1978. Contract EX-76-C-01-1237. 85p. (FE—1237-11). Dep. NTIS, PC A05/MF A01.

The objective of the program is to design, construct and test a multicell fluidized-bed boiler as a pollution-free method of burning high-sulphur coal or burning highly corrosive coals without excessive maintenance problems. The fluidized-bed boiler will provide approximately 300,000 pounds of steam per hour. Steam pressure and temperature conditions were selected to meet requirements of the site at which the boiler is being installed. Initial operations of the Rivesville demonstration plant are reported. Various studies related to fuel feeding systems, limestone preparation and comparative evaluations, engineering modifications and materials testing results are described. (LTN)

6446 **Gas furnace for the secondary smelting of iron.** Salikhodzhaev, S.S.; Iskanderov, S.G.; Abduvasikov, A.A.; Arzamov, Sh.K.; Odabash, Ch.A. *Gazov. Prom-st.;* No. 5, 52-54(May 1977). (In Russian).

A description is given for the construction of a gas iron.-smelting furnace which assures the production of quality casting in the process of secondary smelting of pig iron

6447 **Calculation of heat exchange in radiant tube furnace chambers.** Bakhshiyan, Ts.A.; Volkov, N.F.; Shakhova, L.G. *Khim. Tekhnol. Topliv Masel;* No. 6, 26-29(1977). (In Russian).

An examination is made of the physical bases of total and zonal methods of calculation in furnace chambers as applicable to new designs of tube furnaces. Correlations were found between zonal and total characteristics of radiative heat exchange in a furnace chamber. Practical recommendations are given for determining the total heat transfer of tub furnace burners with a fuel spray, with flat fuel combustion, and for non-flame combustion furnaces. 2 tables, 16 references.

6448 **Study of combined pulverized coal and bark firing in industrial boilers.** Marks, W.R.; Witkowski, S.J. (Babcock and Wilcox Co., North Canton, OH). pp 181-189 of TAPPI conference papers: 1976 engineering. Book 1. Atlanta; Technical Association of the Pulp and Paper Industry (1976).

From TAPPI engineering conference; Houston, TX, USA (4 Oct 1976).

The design of pulverized coal and bark boilers and their evolution from the last fifteen years to the present is studied. Consideration is given to the impact of fuel availability and to the impact of the Environmental Protection Agency regulations on unit design. Also discussed are factors involved when future and other fossil fuels are included. One pitfall to be avoided when designing for future capability is that of overdesign. To design a boiler for an extreme condition which may never be realized is both costly for the buyer and often difficult for the designer.

UNDERGROUND ENGINEERING

REFER ALSO TO CITATION(S) 5111, 5113

6449 **Mining machine.** Askew, W. (to Dresser Europe, SA). US Patent 4,099,787. 11 Jul 1978. Priority date 23 Apr 1976, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A conveyor-mounted mining machine incorporates at least two driving units. Each unit comprises a linearly drivable member operatively engaged with a driven wheel coupled by a clutch to a driving wheel drivingly engaged with a stationary part of the conveyor. With the clutch engaged, linear motion of the linearly drivable member imparts rotary drive to the driving wheel so as to propel the machine along the conveyor. The driving units are operated sequentially so that a continuous drive effort acts on the machine.

6450 **ECSC research and the fight against dust in mines and in the steel industry.** Lemoine, P. *Ann. Mines;* **184**: No. 1-2, 147-156(Jan 1978). (In French).

The areas in which the ECSC has financed research relating to dust are indicated.

6451 **Data collected by the shock wave data center and applications of its output.** Van Thiel, M. (Univ. of California, Livermore). *CODATA Bull.;* No. 23, 37-41(May 1977).

From 5. international CODATA conference; Boulder, CO, USA (Jun 1976).

Methods and equipment used for obtaining shock wave data, the compilation of shock wave data, and uses of these data are described. (LCL)

6452 Electronic distance measurement in mine surveying. Modak, R.N. *J. Mines, Met. Fuels;* **25**: No. 3, 83-86(Mar 1977).

A basic account of EDM and its application in the mining industry is given, together with a recommendation for its use in Indian mines.

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 5155

6453 Subsea energy power supply. Silcox, W.H. (to Chevron Research Co.). US Patent 4,095,421. 20 Jun 1978. Filed date 26 Jan 1976. 12p.

A negative energy power supply is described which operates submerged equipment like a hydraulic actuator. A main component of the system is a submerged chamber held at substantially atmospheric pressure. It is connected to submerged equipment having intake and discharge ports controllable by remotely operated valves. When the intake port is opened to water at the submerged depth of the equipment and the discharge port is vented to the chamber, the resulting pressure difference operates the submerged equipment. The system can also have appropriately connected to it a pressure amplifier to increase the water pressure at a submerged location and a pump to purge the chamber.

6454 Offshore platforms. Bell, A.O.; Smith, W.A.J.R. (to Danbury Drilling Ltd.). US Patent 4,090,368. 23 May 1978. Priority date 19 Dec 1974, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

An offshore platform is described including a deck with an aperture formed through it and a number of clamping means carried by the deck. The clamping means, which may comprise opposed doors, are mounted so as to be selectively movable between a retracted position, to leave the aperture freely open, and an extended position in which the clamping means extend into the aperture. The arrangement is to facilitate lowering and recovering heavy equipment such as a BOP stack.

6455 Offshore drilling platform with vertically movable legs. Verschure, P.J.M. US Patent 4,090,367. 23 May 1978. Filed date 6 Apr 1976. 6p.

An offshore drilling platform with vertically movable legs is described which comprises a buoyant body and a plurality of legs for supporting the body on the sea floor at an elevation above the water level. To permit floating the body for transportation, the legs are selectively vertically movable relative to the body; and in the present invention, this is effected by providing vertical racks on the legs that engage with power-driven pinions carried by the body. The pinion drive has two free-wheel devices, one which free wheels in one direction, and the other which free wheels in the other direction. Each free wheel is clutch connected to the pinion drive, so that when the legs are at an intermediate stage of being raised or lowered, and the platform is at about water level and the bottoms of the legs engage the sea floor, the appropriate free wheel is utilized to let the wave action speed the movement of the legs and platform relative to each other in the same direction that they are being more slowly driven by the pinion drive. In this way, the pounding of the bottoms of the legs on the sea floor is greatly diminished. Also, a system of slides and resilient connections between the legs and the platform absorbs the shocks and reduces the stresses between these elements.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 5723, 5726, 5727, 5728, 5729, 5733, 5734, 5735, 6441, 6442

6456 (CONF-7706129—, pp 11p, Paper 14) **Lime-slurry-scrubbing system in operation.** Rasor, J.B. (Air Force, Rickenbacker Air Force Base, OH). 1977.

From AIPE annual convention proceedings; Atlanta, GA, USA (20 Jun 1977).

In 1977 AIPE annual convention proceedings.

A demonstration pollution-control project underway at Rickenbacker AFB near Columbus, Ohio is described. The lime-slurry-scrubbing process was developed by the A. B. Bahco Ventilation Company of Sweden, and licensing rights were acquired in this country by Research-Cottrell of Bound Brook, New Jersey, in 1971. This is the first industrial size SO_2^- and particulate-removal system using lime as the scrubbing medium in the United States. This installation was contracted as a turnkey project with Research-Cottrell as the prime contractor. Included were design, fabrication, erection, and acceptance testing. In a separate agreement, with the Air Force as agent, Federal EPA provided funds for additional testing of the process, extending over a one-year period. This additional testing is in progress now to evaluate varius turn-down ratios, varying sulfur/coal concentrations, use of limestone and water plant waste lime slurry as reagent, and other scrubber operating parameters. Six distinct functional items include a mechanical collector, forced-draft fan, scrubber tower, lime-handling tower, thickener tank, and sludge pond. Each component and its operating characteristics are described. The Research-Cottrell/Bahco lime slurry scrubber has proven itself both technologically and economically at Rickenbacker AFB. Its operating cost is $4.97 per ton of coal burned versus a cost differential of $12.00 per ton for low-sulfur over high-sulfur coal. Even with low sulfur coal, a particulate problem would remain. (MCW)

6457 (EPA—600/7-77-073c, pp 107-131) **Environmental assessment of afterburner combustion systems.** Barrett, R.E. (Battelle Columbus Labs., OH). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume III.

This research program was initiated with the overall objective of assessing the performance of afterburner emission control devices by evaluating (1) the potential of afterburners for reducing emissions; (2) the potential for afterburners to generate emissions; and (3) the efficient utilization of fuel in afterburners, as it relates to emission control. The program is divided into two phases. Phase I includes the utilization of available data (from the literature, from EPA source tests, from state and local agency data, etc.) to update afterburner technology, to determine emissions from afterburners, to determine the effectiveness of afterburners for destroying pollutants in the inlet stream, and to relate the emissions control effectiveness of afterburners to their fuel consumption. Phase II consists of 4 tasks: two that are directed at generating new data on afterburner performance, and two that are directed at documenting the environmental and engineering aspects of afterburner application. The experimental tasks are directed toward obtaining new afterburner performance data in the field and the laboratory, respectively. The final two tasks consist of utilizing the data generated in the experimental program to complete the environmental assessment of afterburners begun in Phase I, and of developing a "Standard Practice Manual". The manual will assist engineers in deciding when afterburners should be used, which types of afterburners are best suited to specific applications, and what should the design criteria be (in terms of emissions, afterburner efficiency, required temperatures, fuel requirements, etc.).

6458 (EPA—600/7-77-073c, pp 141-192) **Investigation of staging parameter for NO/sub x/ control in both wall and tangentially coal fired boilers.** Brown, R.A.; Mason, H.B.; Neubauer, P. (Acurex Corp., Mountain View, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume III.

Tests on an EPA 1 to 1.5 x 10^6 Btu/hr pilot scale pulverized coal furnace show that NO/sub x/ emissions of 100 to 150 ppM (zero percent O_2) are achieveable with the use of two stage combustion. Comparable NO/sub x/ emission levels were obtained with three different coal types fired in either the single-wall or tangential configuration. On the basis of these tests, the combustion conditions leading to minimum NO/sub x/ appear to be: operation of the primary flame zone at 75 to 85 percent of stoichiometric air; complete separation of stage air from the first stage; first stage mean residence time of 3 to 5 seconds; and high first stage volumetric heat release rate and/or high first stage combustion air preheat. Additionally, the minimum NO/sub x/ condition was achieved using the same burners as were used in uncontrolled operation to simulate full scale equipment. Tests to date have explored the effects of first and second stage combustion conditions on NO/sub x/ production with three types of coal; fired in a five-burner, single-wall configuration, in a four-burner tangential configuration and in a four-burner horizontal tunnel configuration. First stage conditions varied were stoichiometry; residence time to injection of stage air; volumetric heat release rate; combustion air preheat; and fuel/air mixing (swirl, injector design). Second stage variables were residence time to the convective section, stage air preheat and stage air injector design. A possible design for a 500 MW boiler is presented which shows that utilizing a long first stage residence time under fuel rich conditions increases the boiler size by only 5 percent. Of course, the practical application of this design is dependent upon the availability of cost effective materials for the fuel-rich first stage.

6459 (EPA—600/7-77-073c, pp 193-228) **Design criteria for stationary source catalytic combustors.** Kesselring, J.P.; Krill, W.V.; Kendall, R.M. (Acurex Corp., Mountain View, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume III.

The use of catalysts in place of conventional burners for promoting hydrocarbon oxidation reactions appears to have advantages in the control of emissions. In addition, it is possible to achieve high system efficiency through appropriate system design, while holding the catalyst bed temperature to its operating limit. The objective of this program is to produce a new combustion system capable of extremely low emissions performance at the highest system efficiency achievable. Design criteria for catalytic combustors include information on the catalyst/washcoat/substrate, the catalyst life, the preheat requirement for combustion air, and the maximum flow velocity and bed temperature that can be achieved in the system. Based on the results of an extensive catalyst screening program, an extremely active and durable catalyst system has been developed. The system, called the graded cell catalyst, incorporates three 1-inch long sections of alumina with varying cell diameters in a 3-in. bed. The catalyst used was platinum with a loading varying from 5 percent to 1.7 percent by weight. This system was tested at bed temperatures between 2,000°F and 2,700°F with four fuels (natural gas, propane, indolene, and methanol) under both rich and lean combustion conditions for a total test time of nearly 80 hrs. Excellent performance was obtained throughout the test period; typical emissions at 217 percent theoretical air and space velocity of 97,600 ft^3hr/ft^3 are 17 ppM CO, 10 ppM UHC, and 2 ppM NO. The graded cell catalyst system is now being incorporated into several combustion system designs.

6460 (EPA—600/7-77-073c, pp 229-251) **Status of flue gas treatment technology for control of NO/sub x/ and simultaneous control of SO/sub x/ and NO/sub x/.** Mobley, J.D.; Stern, R.D. (Environmental Protection Agency, Research Triangle Park, NC). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume III.

The status of flue gas treatment technology for control of NO/sub x/ and simultaneous control of NO/sub x/ and SO/sub x/ applicable to stationary combustion sources is presented. Dry processes and wet processes are described and applications discussed with respect to performance, operating experience, and economics. As a result of a very stringent NO/sub x/ ambient standard in Japan, the Japanese NO/sub x/ flue gas treatment technology appears to be the most advanced in the world. For this reason, Japanese technology is emphasized in the paper. EPA's past, current, and planned flue gas treatment program is also discussed.

6461 (EPA—600/7-77-073e, pp 31-62) **NO/sub x/ control techniques for package boilers: comparison of burner design, fuel modification, and combustion modification.** Cichanowicz, J.E.; McComis, C.; Heap, M.P. (Energy and Environmental Research Corp., Santa Ana, CA). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

Techniques available for controlling the emission of NO/sub x/ from industrial and commercial boilers are reviewed. The three control options discussed are fuel selection, flue gas recirculation, and combustion air staging. Data are presented on the impact of each method on thermal efficiency, and on NO/sub x/ emissions from the combustion of fuel oils, natural gas, methanol, propane, and kerosene. (LCL)

6462 (EPA—600/7-77-073e, pp 119-141) **Emission characteristics of small stationary diesel engines.** Wasser, J.H.; Statnick, R.M. (Environmental Protection Agency, Research Triangle Park, NC). Jul 1977.

From 2. symposium on stationary source combustion; New Orleans, LA, USA (29 Aug 1977).

In Proceedings of the second stationary source combustion symposium. Volume V.

Investigations of emissions from stationary reciprocating internal combustion engines are described. The initial phase of the in-house research program is described. The work was directed at increasing understanding of air pollutant emissions from small stationary diesel engines and involved evaluation of the use of emulsified fuel and a catalytic reactor as emission control methods. A series of experiments was designed to evaluate the emissions from a small diesel engine, the effects of emulsified fuel on these emissions, and the emission characteristics of a catalytic reactor incorporated in the engine exhaust system. All experiments were run in random order and daily baselines were determined to eliminate atmospheric condition effects on emission levels. Results with the Caterpillar D334 engine show that the major air pollution problems for small diesel engines are the NO/sub x/, CO, and fine particulate emissions. The precombustion chamber design was effective in controlling thermal NO/sub x/ emissions above the 40 kW load point. Water-fuel emulsification had a mixed effect on the emissions: NO/sub x/ was dramatically reduced (60 to 80 percent), but CO emissions were increased by factors of 2 to 5. Further study of effects on particulates and fuel consumption is needed. The catalytic converter reduced CO emissions by over 90 percent and hydrocarbons by over 80 percent. The adverse effects of the converter included a 15 to 20 percent increase in NO/sub x/ and the creation of a significant sulfate emission that was not present in the unmodified engine. (LCL)

6463 **Two stage electrostatic precipitator.** Milum, J.L. (to Emerson Electric Co.). US Patent 4,089,661. 16 May 1978. Filed date 12 Jan 1977. 4p.

An electrostatic precipitator is described that has an ionizing section including a series of positively charged fine wires in equally spaced parallel relationship and a collector section including alternate positive and negative plates equally spaced and parallel with the ionizing wires and in which three negative plates of the collector section are extended into the ionizing section adjacent each wire to provide three electrostatic fields.

6464 **Catalyst for the decomposition of nitrogen oxides.** Sermon, P.A. (to Johnson, Matthey and Co., Ltd.). US Patent 4,088,604. 9 May 1978. Priority date 6 Mar 1974, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

Catalysts which may be used in the purification of air and other gaseous media are described. More particularly, the invention relates to catalysts which may be used in the decomposition of one or more of the oxides of nitrogen comprising a mixed oxide of iron and cobalt.

6465 **Method for controlling removal of hydrogen sulfide from gases.** Mancini, R.A.; Cyr, D.M. (to Air Resources, Inc.). US Patent 4,011,304. 8 Mar 1977. Filed date 5 Mar 1975. 10p.

Hydrogen sulfide is removed from a gas stream in an oxidation-reduction system by contacting the gas stream with an aqueous chelated iron solution in which the iron is in the ferric state to absorb hydrogen sulfide and convert it to elemental sulfur. The solution is regenerated by aeration. A redox electrode is used to monitor the oxidation potential of the solution, and corrective action is taken, as required, to maintain the concentration of ferric iron in the solution so as to achieve efficient removal of hydrogen sulfide.

OTHER

REFER ALSO TO CITATION(S) 5703

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

6466 (BNL—50832) **Low beta accelerator for xenon.** Keane, J.T. (Brookhaven National Lab., Upton, NY (USA)). 3 Apr 1978. Contract EY-76-C-02-0016. 13p. Dep. NTIS, PC A02/MF A01.

The xenon accelerating structures fabricated at BNl are described. Low level measurements yielded a Q value of 1600 and effective shunt impedance of 50 megaOMEGA/meter. For the 20 KW of rf available an energy gain of 400 keV appears attainable.

6467 (CONF-771203—, pp 517-518) **Linear Accelerator-Breeder (LAB).** Steinberg, M.; Powell, J.R.; Batchelor, K.; Kouts, H.J. (Brookhaven National Lab., Upton, NY). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6468 (CONF-771203—, pp 519-521) **Materials technology for the accelerator production of fissile isotopes.** Horak, J.A. (Oak Ridge National Lab., TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

6469 (LA—7323) **TM_{01} mode accelerating cavity optimization.** Manca, J.J.; Knapp, E.A. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 27p. Dep. NTIS, PC A03/MF A01.

The cost of an accelerator depends greatly upon the effective use of rf power for particle acceleration. Before completing an

accelerator design, an optimization of the accelerating cells relative to the effective shunt impedance should be made to measure the structure's efficiency in providing a high and effective acceleration of particles for a given rf power. Optimization of the accelerating cell resonant at f/sub r/ = 1350 MHz (TM_{01} mode) relative to the maximum effective shunt impedance ZT^2 was performed at the Los Alamos Scientific Laboratory using the computer program SUPERFISH. The study was parametric; one parameter was changed while the others were held constant. Frequency adjustments were made by changing the cavity radius. Results presented in this report can be used to design similar cavities at different resonant frequencies or to design a more complicated cavity (TM_{02} mode) for the disk and washer structure.

6470 (LA—7382-MS) **Costs of electronuclear fuel production.** Flaim, T.; Loose, V. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

The Los Alamos Scientific Laboratory (LASL) proposes to study the electronuclear fuel producer (EFP) as a means of producing fissile fuel to generate electricity. The main advantage of the EFP is that it may reduce the risks of nuclear proliferation by breeding ^{233}U from thorium, thereby avoiding plutonium separation. A report on the costs of electronuclear fuel production based upon two designs considered by LASL is presented. The findings indicate that the EFP design variations considered are not likely to result in electricity generation costs as low as the uranium fuel cycle used in the US today. At current estimates of annual fuel output (500 kg ^{233}U per EFP), the costs of electricity generation using fuel produced by the EFP are more than three times higher than generating costs using the traditional fuel cycle. Sensitivity analysis indicates that electronuclear fuel production would become cost competitive with the traditional uranium fuel cycle when U_3O_8 (yellowcake) prices approach $1000 per pound.

6471 (LA—7431-MS) **Annotated bibliography of LAMPF research and development.** Jameson, R.A.; Roybal, E.U. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 254p. Dep. NTIS, MF A01.

Portions of document are illegible.

A bibliography on published and in-house technical material written on LAMPF activities since its inception is presented. Subject and author concordances provide cross-reference to detailed citations, which include an abstract and notes on the material. The bibliography resides in a computer database that can be searched for key words and phrases.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 6474

AUXILIARIES AND COMPONENTS

6472 (BNL—50833) **20 kW transmitter for CW operation at 50 or 17 MHz.** Keane, J.T. (Brookhaven National Lab., Upton, NY (USA)). 4 Apr 1978. Contract EY-76-C-02-0016. 20p. Dep. NTIS, PC A02/MF A01.

A 20 KW transmitter was loaned to the HIF group from the Lawrence Berkeley Laboratory, Berkeley, California. The unit has been put into operation and run at 16 and 50 MHz. The circuitry and difficulties encountered are described.

6473 **High-current power supply for accelerator magnets.** Bourkland, K.R.; Winje, R.A. (to United States Dept. of Energy). US Patent 4,084,109. 11 Apr 1978. Filed date 8 Jun 1976. 8p. PAT-APPL-694,118.

A power supply for controlling the current to accelerator magnets produces a high current at a precisely controlled time rate of change by varying the resonant frequency of an RLC circuit that includes the magnet and applying the current to the magnet during a predetermined portion of the waveform of an oscillation. The current is kept from going negative despite the reverse-current characteristics of thyristors by a quenching circuit.

STORAGE RINGS

6474 (BNL-tr—663) **Magnetization effects in electron cooling.** Derbenev, Ya.S.; Skrinskii, A.N. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1977. Translation by S.J. Amoretty of IYaF—77-40. 27p. Dep. NTIS, MF A01.

A study is made of cooling in an electron beam which is accompanied by a strong magnetic field and a longitudinal temperature low compared to the transverse temperature. It is shown that the combination of two factors—magnetization and low longitudinal temperature of electrons—can sharply increase the cooling rate of a heavy-particle beam when the velocity spread is smaller than the transverse spread of electron velocities and reduce its temperature to the longitudinal temperature of the electrons, which is lower than that of the cathode by several orders of magnitude. (RWR)

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 5845

6475 (BNL—24440) **Charge dividing mechanism in position-sensitive detectors.** Radeka, V.; Rehak, P. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 11p. (CONF-781033—2). Dep. NTIS, MF A01.

From NS symposium; Washington, DC, USA (18 Oct 1978). Portions of document are illegible.

A complete charge-division mechanism, including both the diffusion and the electromagnetic wave propagation on resistive electrodes, is presented. The charge injected into such a transmission line divides between the two ends according to the ratio of resistances and independently of the value of the line resistance, of the propagation mechanism and of the distribution of inductance and capacitance along the line. The shortest charge division time is achieved for Rl = 2π (L/C)/sup 1/2), where R, L, C are resistance, inductance and capacitance per unit length and l is the length of the line.

6476 (ORNL—332(Rev.5)) **Health physics instrument manual.** Gupton, E.D. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 84p. Dep. NTIS, PC A04/MF A01.

The purpose of this manual is to provide apprentice health physics surveyors and other operating groups not directly concerned with radiation detection instruments a working knowledge of the radiation detection and measuring instruments in use at the Laboratory. The characteristics and applications of the instruments are given. Portable instruments, stationary instruments, personnel monitoring instruments, sample counters, and miscellaneous instruments are described. Also, information sheets on calibration sources, procedures, and devices are included. Gamma sources, beta sources, alpha sources, neutron sources, special sources, a gamma calibration device for badge dosimeters, and a calibration device for ionization chambers are described. (WHK)

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 6476

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 5276

6477 (CONF-780734—3) **Gaussian optics calculations of the parameters of a magnetic sector energy analyzer.** Zaluzec, N.J. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From Workshop on analytical electron microscopy; Ithaca, NY, USA (24 Jul 1978).

The design of a magnetic deflection system for use as an electron energy loss spectrometer can be a complex process if one takes the most general approach. However, for application to materials research the design process can be reduced to three basic steps. First, the qualitative features of the overall system are defined--i.e., incident electron energy, required resolution, type of magnet, the desired focal properties, etc. Secondly, the design parameters necessary to meet these requirements are calculated using the appropriate equations. Finally, once the magnetic field has been specified, ray-tracing techniques can be employed to verify the system response to the conditions defined in the first two steps. The calculation of the parameters of a uniform field magnetic sector analyzer capable of energy resolutions of 20 ppM or better are considered. Higher resolution is attainable; however, for most materials work, more important considerations are the attainment of double focusing to improve S/N, the minimization of aberrations and the achievement of a flat image plane to facilitate parallel data recording.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 6908

RADIOMETRIC INSTRUMENTS

REFER ALSO TO CITATION(S) 5165, 5180, 5229, 5286

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

6478 (SAND—78-0777C) **Effects of neutron irradiation and x-ray bombardment on actively biased Si avalanche photodiodes.** Barnes, C.E. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 2p. (CONF-781107—1). Dep. NTIS, MF A01.

From Government microcircuit applications conference; Monterey, CA, USA (14 Nov 1978).

Portions of document are illegible.

The results of a study of the effects of both neutron and X-ray irradiation on Si APD's biased to M greater than or equal to 100 during irradiation are presented. The results indicate that neutron irradiation of actively biased APD's is beneficial as long as the fluence for a negative temperature coefficient is not reached. Further, by selection of an APD with sufficient internal series resistance, the device can survive γ's of significant magnitude at practical M values without the necessity of a large external current limiting resistor. Although large numbers of APD's from a wide variety of manufacturers were not examined, the results presented in this study are encouraging enough to warrant serious consideration and testing of APD's by designers of fiber-optic data links which must tolerate exposure to radiation environments.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 4968, 4970, 5003, 6256, 6333, 6407, 6514, 6543, 6544, 6550, 6552, 6553, 6555, 6732

6479 (LA-UR—2129) **Simulation and preliminary performance characteristics of a computed tomography device for industrial applications.** Kruger, R.P.; Cannon, T.M.; Lundy, A.S.; Morris, R.A. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 7p. (CONF-780829—6). Dep. NTIS, PC A02/MF A01.

From 22. symposium and instrument display; San Diego, CA, USA (28 Aug 1978).

A computed tomography system designed to function in an industrial environment is being constructed. The modular design maintains the flexibility necessary in an environment where source strength and energy, as well as detector type, could change with each application. The static nature of industrial objects also allow economies of design not possible where dynamic objects are to be analyzed. Simulation of the device has been completed and expected image qualities obtained.

6480 (LBL—7274) **Optical timing receiver for the NASA Spaceborne Ranging System. Part I. Dual peak-sensing timing discriminator.** Leskovar, B.; Lo, C.C.; Zizka, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1978. Contract W-7405-ENG-48. 37p. Dep. NTIS, PC A04/MF A01.

Position-resolution capabilities of the NASA Spaceborne Laser Ranging System are essentially determined by the time-resolution capabilities of its optical timing receiver. The optical timing receiver consists of a fast photoelectric device; (e.g., photomultiplier or an avalanche photodiode detector), a timing discriminator, a high-precision event-timing digitizer, and a signal-processing system. The time-resolution capabilities of the receiver are determined by the photoelectron time spread of the photoelectric device, the time walk and resolution characteristics of the timing discriminator, and the resolution of the event-timing digitizer. It is thus necessary to evaluate available fast photoelectronic devices with respect to their time-resolution capabilities, to design a very low time walk timing discriminator and to develop a high-resolution event-timing digitizer which will be used in the high-resolution spaceborne laser ranging system receiver. The development of a new dual-peak sensing timing discriminator is described. The amplitude dependent time walk is less than +-150 psec for a 100:1 dynamic range of Gaussian-shaped input signals having pulse widths between 11 and 17 nsec. The unit produces 800 mV negative output pulses, each 10 nsec wide, and 3V positive pulses with widths of 15 nsec. The time delay through the discriminator is approximately 37 nsec. In this discriminator the input signal is processed by a peak-crossing circuit which produces a bipolar pulse having its zero-crossing point at the peak of the input signal. All essential functions in the discriminator are performed by means of tunnel diodes with backward diodes as nonlinear loads. The discriminator is designed to be CAMAC compatible to a conventional time-interval unit or a high-precision event timing digitizer. The adjustment procedure for obtaining minimum time walk is also given.

6481 (LBL—8031) **Zeeman atomic absorption spectrometry.** Hadeishi, T.; McLaughlin, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 134p. Dep. NTIS, PC A07/MF A01.

The design and development of a Zeeman atomic absorption spectrometer for trace element analysis are described. An instruction manual is included which details the operation, adjustment, and maintenance. Specifications and circuit diagrams are given. (WHK)

6482 (SAND—78-0698) **Fluid coupled plate (FCP) gage.** Cook, C.W.; Ames, E.S. (Sandia Labs., Albuquerque, NM (USA)). Aug 1978. Contract EY-76-C-04-0789. 29p. Dep. NTIS, PC A03/MF A01.

A fluid coupled plate (FCP) gage was designed which allows pressure measurements to be made in harsh environments (including debris) using conventional pressure transducers. The pressure transducer is isolated by means of a rigid force plate which is supported by a bellows having one corrugation. This portion of the gage is machined from a single piece of material. The interior of the gage is filled with a phenol fluid which has a low compressibility. Thermal transients are isolated from the coupling fluid by the thermal delay provided by the force plate. A linear response is achieved by prepressuring the phenol fluid. Extensive laboratory tests indicate that the ECP has a response time of less than 20 microseconds. For inputs in excess of 200 MPa, a ytterbium piezoresistive grid is used for the readout. When an ultra-high-strength stainless steel force place bellows was used, an input of 419 MPa did not damage the gage.

6483 (UCID—80821) **Design strategy for microprocessor controlled instrumentation.** Trost, S.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1978. Contract W-7405-ENG-48. 5p. (CONF-781107—4). Dep. NTIS, PC A02/MF A01.

From Government microcircuit applications conference; Monterey, CA, USA (14 Nov 1978).

Weapons design activities at Lawrence Livermore Laboratory rely heavily on diagnostic testing for experimental verification of computer code predictions. These tests are quite complex and often involve assemblies which are tested to destruction. Such tests, by their nature, are expensive; it is thus necessary to provide instrumentation systems which achieve as high a level of reliability as possible. In order to provide rapid design turnaround time and reliable instrumentation and systems, a design strategy has been developed which is used when new equipment is designed. The primary elements of this strategy are as follows: (1) use of standard hardware modules; (2) use of standard software modules; (3) provision for local and remote control; (4) provision for self test while operating; (5) provision for self test (maintenance) mode; and (6) use of high level programming languages. The need for a design strategy and the rationale for the above criteria are discussed, and then two examples of equipment which have been designed are detailed.

6484 **Device for measuring the thickness of layers with a radionuclide irradiating the layer.** Ott, A. US Patent 4,089,054. 9 May 1978. Priority date 18 Mar 1976, German, Federal Republic of (F.R. Germany). 8p.

A normalized count from a digital computer in a layer-thickness measuring device of the beta ray back-scatter type, is fed to a digital-analog converter and a correction circuit which realizes the function X/sub n corr/ = X/sub n/ + A x a_2X/sub n//sup p/ (1-x/sub n/)/sup q/ and then to an indicator having a non-linear scale, in which X/sub n/ is the normalized count, A is a dimensionless number between +1 and -1, a_2 is a dimensionless number between n + 0.1 and -0.1, and p and q are dimensionless positive values around unity but different from one another which are permanently wired into the correction circuit.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 5097, 5165, 5167, 5168, 5169, 5171, 5172, 5173, 5174, 5175, 5176, 5177, 5178, 5179, 5180, 5181, 5182, 5183, 5192, 5229, 5230, 5244, 5282, 5286, 5655, 5656, 5665, 6417, 6418, 6419, 6820, 6836

6485 **Study of the relationship between two intrinsic reservoir parameters, the lithologic influence factor, and the pore geometrical factor.** Barlai, Z.; Mawla, R.A.; Al-Saadoon, F.T. (Al-Fateh Univ., Tripoli, Libya). pp I1-I17 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

For a better characterization of a porous medium and for a better understanding of some complicating effects in quantitative interpretation of reservoir parameters, two compounded intrinsic petrophysical factors are utilized. These two factors are, namely; the lithologic influence factor and the pore geometrical factor. Theoretical studies and experimental investigations have been carried out in order to relate the pore geometrical factor to the lithologic influence factor. It has been concluded that a close and direct relationship exists between those two factors. Those two factors are favorably used for characterizing microscopically the complexity of the pore structure of the reservoir. The lithologic influence factor, which is a well logging parameter, can be obtained as a continuous record along the borehole axis. The pore geometrical factor, which is a special core analysis parameter, can be evaluated for individual core samples. Thus, a quantitative relationship between the two factors will make the pore geometrical factor available in a continuous form. Thus, this paper deals with the correlation of a well logging parameter, namely; the lithologic influence factor, with a special core analysis parameter, namely; the pore geometrical factor.

6486 Analysis of geophysical data in clayey sands. Modified Fertl method. Flores, M.L.; Garza de la Garza, R. (Petroleos Mexicanos, Reynosa, Mexico). pp L1-L18 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978). (In Spanish)

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

A method for the analysis of geophysical data in clayey sands, based on the published work of Walter H. Fertl, is presented. In the method it is considered that the resistivities of the formation water (R/sub w/) are not of high salinity so they can be disregarded with respect to the resistivity of the disseminated clay. Some modification are included for the determination of the water saturation when the constant a, function of tortuosity, and the cementation factor m are not known. The variation of the water saturation is also included in order to vary the saturation exponent of the washed zone (n') when the resistivity of the mud filtrate (R/sub mf/), permeability (K), and water salinity (P) are taken into consideration and the resistivity of the disseminated is considered variable.

6487 Well log interpretation of shaly sands with the programmable calculator. Thompson, K.D. (Schlumberger Well Services, Corpus Christi, TX). pp X1-X27 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

Algorithms for the programmable calculator are described for level-by-level, open-hole, shaly-sand analysis for use with three log combinations: (1) resistivity and Sonic logs only; (2) resistivity, Formation Density, Compensated Neutron, and Gamma Ray logs only; and (3) resistivity, Sonic, Formation Density, Compensated Neutron, and Gamma Ray logs. The SP may also be used as a shaliness indicator. An algorithm for cased-hole logs is also described, which uses the Dual-Spacing Thermal-Decay-Time log and a Gamma-Ray log. The interpretation utilizes the dual-water model of shaly sands. Level-by-level values of water saturation, porosity, and bulk-volume-shale fraction are generated from the calculator programs. Both open-hole and cased-hole example logs are analyzed and interpreted. Results are compared with computer-processed interpretations made on the same wells. The calculator interpretations do not provide certain features of the computer products, nor are they as accurate. However, they enable the well operator to make expedient decisions on core points, formation-test points, and pipe setting.

6488 Method of autocalibration and its computer applications / Saik system/. Frydecki, J. (Warsaw Univ.); Debski, Z.; Basista, S. pp Y1-Y57 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

The paper presents an original method of autocalibration against the background of the current knowledge of methods identifying the mineral composition of rocks. Autocalibration is an attempt to solve the problem of quantitative interpreting the results of well logging. On the basis of this method a system was developed of automatic complex interpretation of well log data, known as SAIK. The autocalibration method eliminates the necessity to calibrate log data. Neither does it necessitate the use of data resulting from laboratory tests of cores, although the SAIK system can make use of this kind of information. Properly adjusting the crossplot technique by analyzing the limit conditions of given plots, indispensable calibration coefficients can be obtained, which makes it possible to effect the quantitative data interpretation. The use of autocalibration allows the interpreting of measurement data obtained in the past and disqualified at that time due to poor quality and lack of calibration. Autocalibration has the character of a filtration method that separates the information searched for from that coming out as a side effect and embraced by log data. The paper also gives an outline of the SAIK system as an application of the autocalibration method in practice.

6489 Computer-processed wellsite log computation. Best, D.L.; Gardner, J.S.; Dumanoir, J.L. (Schlumberger Well Services, Houston, TX). pp Z1-Z32 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

A new logging unit with an integrated system of surface instrumentation built around a computer allows digitally recorded logs to be merged, computed, and recorded on film at the wellsite. The SCHLUMBERGER CYBERLOOK wellsite computer processing utilizes the recently introduced "Dual Water" interpretation model for reservoir analysis. This model considers a shaly, water-saturated formation to behave as if it contains two types of pore water: "clay water" near the surfaces of clay crystals and "far water" at a distance from the clay surfaces. The processing is designed so that all required input parameters can be accurately selected from a first-pass merge. The computations, corrected for shale and light-hydrocarbon effects, are presented on film in a format that is easily interpreted, allowing decisions to be made at the wellsite. Field experience has shown the processing to be very flexible, providing excellent results throughout North America in both sandstone and carbonate reservoirs.

6490 Application of the method of continued fractions to solve problems of resistance logging. Kulinkovich, A.E.; Gumenyuk, A.I. (Inst. of Cybernetics, Kiev). *Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz.;* No. 77, 72-76(1977). (In Russian).

The method is described for solving a direct problem of resistance logging under conditions of high values for the ratio of specific resistance of the rocks indicated by the borehole and that of the drilling fluid. No penetration is supposed. The law of the rocks specific resistance variation may be arbitrary. The solution is expressed as continued fractions. On the basis of the described method the program of resistance logging computation is compiled for the electronic computer BECM-6.

6491 Actes du troisieme colloque annuel de diagraphies. (Fifth European logging symposium transactions). Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). vp. (CONF-7710157—).

From 5. European logging symposium; Paris, France (20 Oct 1977).

Abstracts were prepared for selected papers.

6492 Seismic applications of sonic logs. Thomas, D.H. (British Petroleum Co., Ltd., London). pp 24p, Paper 7 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977).

From Conference on the problems of radioactive wastes in nuclear technology; Essen, F.R. Germany (20 Oct 1977).

The continuous sonic log was developed to provide a detailed record of velocity for seismologists and even today the majority of sonic logs are run for this purpose, particularly in intermediate and surface runs. An examination of the principle of sonic tools currently used indicates some often overlooked limitations, which can cause severe errors from the seismic point of view (ironically, particularly in surface and intermediate logging runs) even when the logs are routinely calibrated by a well-shoot velocity survey. Improved techniques for log calibration by well-shoot velocity surveys now compensate for limitations of present tools, and new tools which are far less limited are being developed. These will need careful evaluation by the industry. Although current developments may possibly reduce the seismic importance of sonic logs, improved tools will benefit the log analyst.

6493 Quick method of facies analysis from logs. Serra, O. pp 15p, Paper 9 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From Conference on the problems of radioactive wastes in nuclear technology; Essen, F.R. Germany (20 Oct 1977).

The author describes a quick method for faciological analysis from well-logs using a rose-diagram.

6494 Self calibration by SAIK computer system as method of identifying geological parameters of a field. Frydecki, J.; Debski, Z.; Basista,S. pp 60p, Paper 12 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From Conference on the problems of radioactive wastes in nuclear technology; Essen, F.R. Germany (20 Oct 1977).

The principles of the SAIK system for the complex processing of well logging data with automatic calibration of all types of

logs are described. The principal operations in the use of the method are outlined. The errors and the efficiency of self calibration are considered. (JSR)

6495 Cementation exponent in the porosity-formation factor relation: effect of permeability. Raiga-Clemenceau, J. pp 14p, Paper 15 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

Among all the mathematical relations involved in the usual computation of the water-saturation from logs, that occurring between the formation factor and the porosity in a reservoir rock is of prime importance. Usually this relation is expressed under the form F = a x phi/sup -m/ with a and m being arithmetical constants for a given reservoir interval. But observations show a great variability of "a" and "m" values, hence a considerable source of errors when having to assume values for these parameters. By reviewing all physical characteristics of the samples analyzed for the elaboration of the "Humble formula" (a = 0.62 and m = 2.15), a distinct relation appears between the samples permeability and the exponent "m" (cementation exponent) with a = 1. Introducing this "permeability factor" under the form m = 1.28 + 2/Log K + 2 allows for determining F values closer to those measured on samples than are those obtained with the help of the Humble formula. A chart is proposed as an help to solve quickly the equation. Conversely the simultaneous knowledge of porosity and formation factor renders it possible to derive a "permeability index" applicable in water-bearing zones where other log-derived permeability index methods are not workable.

6496 Sonics, moduli, and compactions. Perrier, J. pp 20p, Paper 16 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

A formula is derived from which it is possible to estimate from sonic velocities the value of the elasticity moduli of the rock. The compaction phenomenon of a thick argilaceous series across the variations of the elasticity moduli thus calculated is studied. This leads to a revision of some concepts concerning the relation of compaction, abnormal clays, and abnormal pressures.

6497 Studies in using log data in porous media. Lebreton, F. (Universitaire de Technolgoie, Bordeaux); Sarda, J.P.; Trocqueme, F.; Morlier, P. pp 32p, Paper 19 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

At the present time permeability can not be measured directly by any logging method. As the permeability affects the dissipation of acoustic waves, studies were initiated to develop a method for measuring permeability with sonic logs. A new acoustic index, correlating the first three amplitudes of the compressional wave train, was derived. Preliminary laboratory studies on the correlation of this index with the permeability appear promising enough to recommend its use in the direct measurement of rock permeability in the vicinity of the well wall. (JSR)

6498 Drilling muds and log interpretation. Ricard, G. pp 12p, Paper 20 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

Products used to fabricate drilling muds and the various types of muds obtained by associating differently the mud products are briefly described. The perturbations created in the formation by the muds are analyzed. A qualitative analysis is then made of the factors capable of affecting log interpretation.

6499 Fluorine logging by neutron activation. Dumesnil, P. pp 21p, Paper 21 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

The analysis of fluorine in drilling is achieved by the fast neutron reaction $^{19}F(n,)^{16}N$, followed by counting the photons emitted by ^{16}N. The counting threshold is fixed at a very high value so that the background from natural radioactivity is completely eliminated and the effect of radiative capture photons is reduced considerably. The optimization of fluorine logging requires certain precautions in the selection of the neutron source and the measurement geometry. These are discussed. (JSR)

6500 Effects of hold conditions on log measuments and formation evaluation. Misk, A.; Mowat, G.R.; Goetz, J.; Vivet, B. (Schlumberger Technical Services, Paris). pp 17p, Paper 22 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977).

From 5. European logging symposium; Paris, France (20 Oct 1977).

The advance of enhanced recovery techniques puts heavy emphasis on the accuracy of formation parameter determination. Formation parameters are derived primarily from wireline measurements which in turn are heavily dependent on conditions prevailing in the borehole at the time of the logging operations. This paper reviews the different aspects of hole conditions that will affect the log measurements and supports its conclusions on the evidence of a few typical examples. Practical recommendations are made as regards the choice of drilling parameters, the design of the logging operation, and the computer analysis of wireline measurements so as to ensure the highest degree of reliability of formation parameters.

6501 Parameters affecting neutron logging: matrix effect, mathematical simulation, and application tohe definition of a probe. Hannebicque, L.; Richard, M. pp 40p, Paper 23 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

Fast neutron-slow neutron logging, which is based on neutron slowing down from collisions with hydrogen nuclei, can give erroneous results because of the presence of different matrices for which no or little experimental data is available. This is particularly true of basalt. An attempt is made by a simple analytical treatment of the slowing down and of the diffusion of neutrons to show which physical parameters of the matrix affect the measurement result. A multigroup Monte Carlo calculation is then used to establish with precision the response of a neutron probe in a medium of given chemical composition and to study particularly basalt. From the results obtained recommendations are made on the construction of a neutron probe adapted to one or several particular matrices. (JSR)

6502 PICARDIA: an interpretation program using logs and core data. Serra, O.; Gras, C.; Pied, B.; Hossin, A. pp 31p, Paper 24 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From 5. European logging symposium; Paris, France (20 Oct 1977).

The authors describe PICARDIA, written and currently used by ELF AQUITAINE and CFP TOTAL. After a brief description of the PICARDIA flow chart indicating relations and functions of the different OVERLAYS, the main subroutines are described. The main originalities of this program are: (1) A choice between a point by point or a level by level approach. The later option automatically breaks down the formations into reservoirs and beds with homogeneous characteristics. (2) It is possible to use a maximum of information from core measurements to calibrate accurately the logs or to control the quality of the results or as imposed data.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 5015

6503 (MHSMP—78-34) **Evaluation of four HNS II materials for use in aluminum linear shaped charges. Final report.** Stull, T.W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Aug 1978. Contract EY-76-C-04-0487. 6p. Dep. NTIS, PC A02/MF A01.

The study was undertaken to determine which of four methods for producing HNS II provides optimum material for processing and use in the aluminum linear shaped charged (ALSC). Four materials were prepared, analyzed, and fabricated into a mild detonating fuse (MDF). These were then test fired and the results compared. Chemical and physical tests of the four materials indicate significant differences. However, there were no significant differences in the way the materials handled during processing into MDF or in final test fire results.

NUCLEAR

REFER ALSO TO CITATION(S) 6600

CIVIL USES

REFER ALSO TO CITATION(S) 6251, 6768

WEAPONRY

REFER ALSO TO CITATION(S) 6599, 6601, 6884

6504 (UCID—17847(Rev.1)) **KRS: a fast, special-purpose data base system.** Hage, G.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Sep 1978. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

The K-Division Retrieval System (KRS) is a group of programs and files maintained by the Lawrence Livermore Laboratory to store and recall data about the geology and events at the Nevada Test Site. KRS consists of two large data files that are regularly updated with new information. This report describes these data files and the interaction necessary to use the specialized programs, obtain access to the information, and arrange the data reports. These programs are run on CDC-7600 computers and are available in public files.

6505 (UCRL-Trans—11396) **Is the neutron bomb coming.** Kaplan, F.M. Translated from *Bild Wiss.;* No. 4, 65-76(1978). 19p. Dep. NTIS, PC A02/MF A01.

A general description of the history, development, and possible uses of the neutron bomb is presented. (TFD)

EXPLOSION DETECTION

REFER ALSO TO CITATION(S) 6451

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

6506 (DOE/EV—0024/1) **Inventory of Federal energy-related environment and safety research for FY 1977. Volume I. Executive summary.** Shepard, G.R.; Rose, S.L. (Department of Energy, Washington, DC (USA). Div. of Environmental Impacts). Jul 1978. 55p. Dep. NTIS, PC A04/MF A01.

This inventory provides a listing of federally funded energy-related environment and safety (E and S) research projects for FY 1977. Volume I is the Executive Summary.

6507 (DOE/EV—0024/2) **Inventory of Federal energy-related environment and safety research for FY 1977. Volume II. Project listings.** (Department of Energy, Washington, DC (USA). Div. of Environmental Impacts). Jul 1978. 1218p. Dep. NTIS, PC A99/MF A01.

This volume contains Biomedical and Environmental Research, Environmental Control Technology Research, and Operational and Environmental Safety Research project listings. The projects are ordered numerically by log number.

6508 (DOE/EV—0024/3) **Inventory of Federal energy-related environment and safety research for FY 1977. Volume III. Interactive terminal users guide.** Shriner, C.R.; Peck, L.J.; Miller, C.E. (Oak Ridge National Lab., TN (USA); Department of Energy, Washington, DC (USA). Div. of Environmental Impacts). Jul 1978. Contract W-7405-ENG-26. 53p. Dep. NTIS, PC A04/MF A01.

This users guide was prepared to provide interested persons access to, via computer terminals, federally funded energy-related environment and safety research projects for FY 1977. Although this information is also available in hardbound volumes, this on-line searching capability is expected to reduce the time required to answer ad hoc questions and, at the same time, produce meaningful reports.

BASIC STUDIES

6509 (ATDL—77/23) **Environmental Research Laboratories 1976 annual report.** (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Atmospheric Turbulence and Diffusion Lab.). Sep 1977. 630p. Dep. NTIS, PC A99/MF A01.

Separate abstracts were prepared for 17 sections of this report. A list is included of 28 publications during the time period covered.

6510 (ATDL—77/23, pp 19-41) **Scale height approximations for deposition estimates at extended distances.** Culkowski, W.M. (Air Resources Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

As airborn materials travel beyond 10^5 meters, the vertical profile of material concentration becomes a function of three parameters; the height of the boundary layer, the deposition velocity, and the vertical diffusivity. The effects of these parameters are examined and some simple approximate relationships are presented for the vertical distribution and surface concentration of material with particular reference to surface deposition estimates.

6511 (PNL—2500(Pt.3), pp 2.39-2.40) **Rainfall enhancement due to washout of cooling tower condensate.** Dana, M.T.; Wolf, M.A. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

Theoretical calculations of the washout of cooling tower condensate droplets by frontal raindrops show that rainfall enhancement can be significant and is measurable under typical meteorological and cooling tower effluent source conditions. For the case of moderate rainfall rates and a wind speed of 5 m/sec, centerline rainfall enhancement was as much as 46%, cross-plume average enhancement as much as 7%, and distance to one-half depletion of the source 1 to 10 km.

6512 (PNL—2500(Pt.3), pp 3.1-3.3) **Turbidity variations at Hanford since July 1974.** Laulainen, N.S. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

Spectral turbidity coefficients derived from multiwavelength sunphotometer measurements obtained from July 1974 to December 1976 have been analyzed for seasonal and weekly variations. Weak biannual variations in turbidity are apparent in the data. Day-to-day variations, however, can be much larger than the coefficients for the fitted biannual terms. Consequently, it now appears that observed variations in turbidity at Hanford are related to the synoptic meteorology with a smaller, superimposed seasonality of dust and smoke sources. Turbidity variations are also independent of the day of the week.

6513 (PNL—2500(Pt.3), pp 3.4-3.7) **Differential turbidity measurements at Hanford.** Laulainen, N.S.; Bates, J.A.; Kleckner, E.W.; Michalsky, J.J.; Schrotke, P.M.; Thorp, J.M. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

An experiment to exmine differential turbidity effects on measured insolation between the Rattlesnake Observatory and the Hanford Meteorological Station was conducted during summer 1977. Several types of solar radiation instruments were used, including pyranometers, multiwavelength sunphotometers, and an active cavity radiometer. Preliminary results show dramatic temporal variability of aerosol loading at HMS and significant insolation and turbidity differences between the Observatory and HMS.

6514 (PNL—2500(Pt.3), pp 3.8-3.10) **Atmospheric remote sensing studies performed at Battelle Observatory during August and September 1977.** Stokes, R.A.; Michalsky, J.J.; Schuster, G.J. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

Preliminary remote sensing results presented here indicate that techniques drawn from radio and optical astronomy can be profitably applied to atmospheric problems. A study of tropospheric turbidity using a precision polarimeter in conjunction with a 31-in. optical telescope demonstrated the feasibility of remote measurement of aerosol size distribution. Stratospheric ozone spectra which can be used to infer the mixing ratio and vertical distribution of the molecule were obtained with a newly-developed millimeter wavelength spectrometer.

6515 (PNL—2500(Pt.3), pp 4.1) **Dual tracer deposition experiment.** Sehmel, G.A. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

A dual tracer of depositing lithium particles and nondepositing SF_6 gas is being used to measure dry deposition removal over complex terrain. Sampling equipment is also being tested.

6516 (PNL—2500(Pt.3), pp 4.2-4.4) **Revised method of energy flux calculations over vegetation canopies.** Droppo, J.G. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

The energy budget method for determining sensible and latent heat fluxes has been widely applied in agricultural and forest studies to predict the dry deposition of pollutants. The requirement for accurate vertical gradients and the assumption relating sensible and latent eddy diffusivities, however, limit use of this method. To avoid these limitations, a computation procedure has been developed to equate the vertical flux ratios and storage term ratios of energy terms. The revised procedure is illustrated using data from a deciduous forest.

6517 (PNL—2500(Pt.3), pp 4.4-4.6) **Transport and dispersion in complex terrain: research needs.** Orgill, M.M. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

Since future energy conversion activities in the western United States, such as oil shale production, may have a damaging effect on air quality, air quality assessment methods should supply reliable information about atmospheric transport and dispersion in complex terrain. Unfortunately, current methods are inadequate. This report gives an overall view of the problem of transport and dispersion in complex terrain and reviews and evaluates the research methods and needs required for realistic solutions to the problem.

6518 (PNL—2500(Pt.3), pp 4.6-4.7) **Verification statistic for numerical models.** Kerrigan, T.C. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

A generalized wind estimate based on a limited number of uncertain field measurements is computed at each point in a given geographical region. A point-by-point comparison with a numerical model prediction of the wind field is then described. This comparison results in numerical assessments of the probability that the model succeeded in predicting the actual wind field and that the field measurements contain sufficient information on which to base such a comparison.

6519 **Ozone in London.** Williams, M.L.; Sullivan, E.J. (Warren Spring Lab., Stevenage, Eng.). *Nature (London);* **273**: No. 5661, 407-408(1 Jun 1978).

An objection to a presentation of statistical models for ozone concentrations in London was reported in the Letters to the Editor section. The objection was based on a test of the author's model using monitoring data for the summer of 1976 at County Hall. According to these data and London Weather Centre data, the model underpredicted the ozone values by approximately one-third. Rebuttal by the author was also reported.

6520 **Relationship between atmospheric carbon dioxide and Pacific sea surface temperature.** Newell, R.E.; Weare, B.C. (Massachusetts Inst. of Tech., Cambridge). *Geophys. Res. Lett.;* **4**: No. 1, 1-2(Jan 1977).

There is a spatial and a temporal correspondence between changes in Pacific sea surface temperature and changes in atmospheric carbon dioxide, after seasonal trends have been removed.

RADIOMETRIC TECHNIQUES

6521 (NVO—181, pp 159-172) **Methodology for identification and isolation of fallout particles.** Nathans, M.W.; Soinski, A.J. (LFE Environmental Analysis Labs., Richmond, CA). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Attention is focused on sequences of techniques that can be used for the eventual characterization of debris particles in fallout and soil samples as well as in cloud samples from events of interest to NAEG. These debris particles vary in morphology, radionuclide content, and radionuclide distribution. They always constitute only a small fraction of the total sample. The applied methodology yields both the plutonium (alpha-emitter) concentration as a function of the particle size, and the distribution of plutonium (that is, the PuO_2-equivalent size distribution) over the particles in any size interval. Alpha-emitting particles can be located, photographed, measured, and isolated for further characterization by methods such as scanning electron microscopy and electron or ion probe analysis. Methods used include size separations in a stabilized liquid column, density separations in either a density gradient column or a column with uniform density, alpha radiography, fission fragment radiography, and more mundane methods such as micromanipulation. Some generalized results of the application of these techniques are presented.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 4953, 5091, 5092, 5332, 6348, 6353, 6384, 6509, 6574, 6575, 6636, 6640, 6766

6522 (ANL/EES-TM—10) **Benefit—cost analysis of new source performance standards.** Croke, K.G.; Hoover, L.J.; Farley, D.; Bright, R.N. (Argonne National Lab., IL (USA)). Sep 1975. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

An assessment of the adoption of SO_2 New Source Performance Standards (NSPS) for power generation is presented herein. The cost, effectiveness, and value of new source performance standards were examined in a benefit-cost framework. In order to do this, power plants in Illinois were evaluated with respect to SO_2 emissions, air quality effects, exposure of adjacent populations to SO_2, control costs, and health and property damages. In terms of reducing the dosages to humans of SO_2, it is more cost-effective to control older rural plants than it is to control new rural plants. The cost per man-SOX reduction for new plants would be about $18 per man-SOX versus $10 per man-SOX for existing plants. The costs of the new source performance standards are about 10 times larger than their associated benefits. The reduction in damages per year is about $400,000 while the cost of control is about 8.4 million dollars. Conclusions such as this based on the present state of the art of benefit estimation are, of course, risky; however, the relative cost-effectiveness ratios do seem to indicate a misallocation of resources even if the uncertainties in the benefit estimates are significant.

6523 (ATDL—77/23, pp 245-326) **SULCAL: a model of sulfur chemistry in a plume.** Baes, C.F. Jr.; Holdeman, J.T.; Culkowski, W.M. (Oak Ridge National Lab., TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

A computer program has been written that models the following features of the chemical behavior of sulfur emitted to the atmosphere from fossil-fuel burning power plants: the rapid reactions of SO_2 with aerosol droplets to produce the dissolved sulfite species H_2SO_3, HSO_3^- and SO_3^{2-}; the rapid reactions of SO_3 to produce the dissolved sulfate species HSO_4^- and SO_4^{2-}; the neutralization of the acid thus produced by atmospheric ammonia; the eventual formation of particulate ammonium sulfate; the slow oxidation of SO_2 to sulfate species by hydroxyl radical; and the slow oxidation of species of SO_2 in aerosol droplets to sulfate species by dissolved ozone and oxygen. The model employes averaged concentrations based on the Gaussian plume and can calculate deposition rates for gaseous and particulate material as a function of such variables as distance from the source, wind speed, meteorological stability class, temperature, relative humidity, and the ambient concentrations of OH radical, ozone, and ammonia.

6524 (ATDL—77/23, pp 340-349) **Simulation of atmospheric transport using observed and estimated winds.** Nappo, C.J. Jr. (National Oceanic and Atmospheric Administration, Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

The spread of pollutants in the atmosphere is often mathematically simulated by the linear combination of transport by the mean wind and dispersion by parameterized turbulence. Several questions arise when trajectories are constructed in the plantary boundary layer. How accurately can trajectories simulate the observed positions of an air parcel along the air parcel's path. How accurate are trajectories constructed from surface winds compared with trajectories constructed from winds observed through the depth of the boundary layer. How does atmospheric stability effect the accuracy of trajectory calculations. One of the main objectivies of the Eastern Tennessee Trajectory Experiment (ETTEX) was to obtain a data base sufficient to answer these questions. In this study, the ETTEX pilot balloon wind observations are assumed to be a best realization of the real wind field. These data will be used to simulate the trajectories of tetroons released during stable, unstable and transition periods. For each class of stability, the error of the simulation will be determined at the end of each advection step of the trajectory calculation. The average and standard deviation of these errors form the overall accuracy of the trajectory simulation. These results will then be considered to be the best possible simulations. This procedure will then be repeated using estimated winds derived from vertically extrapolated surface winds. We can then judge the validity of atmospheric transport calculations using observed or estimated winds.

6525 (ATDL—77/23, pp 462-471) **Regional transport model of atmospheric sulfates.** Rao, K.S. (Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN); Thomson, I.; Egan, B.A. Sep 1977.

In Environmental Research Laboratories 1976 annual report.

As part of the Sulfate Regional Experiment (SURE) Design Project, a regional transport model of atmospheric sulfates has been developed. This quasi-Lagrangian three-dimensional grid numerical model uses a detailed SO_2 emission inventory of major anthropoge-

nic sources in the Eastern U.S. region, and observed meteorological data during an episode as inputs. The model accounts for advective transport and turbulent diffusion of the pollutants. The chemical transformation of SO_2 and SO_4/sup =/ and the deposition of the species at the earth's surface are assumed to be linear processes at specified constant rates. The numerical model can predict the daily average concentrations of SO_2 and SO_4/sup =/ at all receptor locations in the grid region during the episode. Because of the spatial resolution of the grid, this model is particularly suited to investigate the effect of tall stacks in reducing the ambient concentration levels of sulfur pollutants. This paper presents the formulations and assumptions of the regional sulfate transport model. The model inputs and results are discussed. Isopleths of predicted SO_2 and SO_4/sup =/ concentrations are compared with the observed ground level values. The bulk of the information in this paper is directed to air pollution meteorologists and environmental engineers interested in the atmospheric transport modeling studies of sulfur oxide pollutants.

6526 (ATDL—77/23, pp 501-510) **Effects of atmospheric parameters on the concentration of photochemical air pollutants.** Gifford, F.A.; Hanna, S.R. (National Oceanic and Atmospheric Administration, Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

The observed values of many of the meteorological variables and pollutant concentrations that are available for the Los Angeles basin for September 29, 1969 are compared with modeling results. Data from CO monitoring stations and wind speed stations were examined. Errors in the numerical urban air pollution model applied to the Los Angeles basin on a typical smoggy day are pointed out.

6527 (BNL—24844) **Comparative study of diffusion classification by lapse rate, gustiness and a modified Pasquill method.** Raynor, G.S.; Hayes, J.V. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 12p. (CONF-780841—2). Dep. NTIS, PC A02/MF A01.

From 9. meeting on air pollution modeling and its application; Toronto, Canada (28 Aug 1978).

Nearly all models for calculating atmospheric diffusion of gases or small particles include parameters to describe the horizontal and vertical diffusion rates. This study was designed to determine the amount of disagreement among three methods for estimating these parameters and to modify procedures for computing the Pasquill stability classes from surface observations to improve agreement. Two years of hourly surface observations and tower measurements including gustiness classes were used. Lapse rates and stability classes were computed. The degree of agreement between these measures of diffusion was calculated and the conditions under which poor agreement occurred were determined. The method of computing the Pasquill classes was modified and results examined. The modified version gave better agreement between computed stability classes and the other methods and gave a more realistic distribution of unstable, neutral and stable classes.

6528 (CONF-7706131—) **8th international laser radar conference. Invited papers.** (Drexel Univ., Philadelphia, PA (USA)). 1977. 139p. American Meteorological Society, Boston, MA.

From 8. international laser radar conference; Philadelphia, PA, USA (6 Jun 1977).

Separate abstracts were prepared for the six papers included.

6529 (CONF-7706131—, pp 31p, Paper 1) **Some directions in laser meteorology.** Derr, V.E. (NOAA Research Labs., Boulder, CO). 1977.

From 8. international laser radar conference; Philadelphia, PA, USA (6 Jun 1977).

In 8th international laser radar conference. Invited papers.

Applications of lidar systems in studies of pollution meteorology are discussed. It is pointed out that lidar can contribute to the determination of characteristics of particulate pollutants and also the study of the dynamics of dispersion. Agricultural and energy related problems require both short and longer term forecasting. It is as yet not completely clear whether lidar will be significant in longer term forecasts, of benefit to agriculture and conservation, or whether its usefulness will be primarily in the study of basic atmospheric processes involving the effect of clouds and aerosols on radiation balance. However, recent studies indicate that lidar will be important, in the future, in global wind sensing from satellites. Lidar and radar systems for cloud observations are compared.

6530 (CONF-7706131—, pp 8p, Paper 2) **Lidar: air pollution applications.** Collis, R.T.H. (Stanford Research Inst., Menlo Park, CA). 1977.

From 8. international laser radar conference; Philadelphia, PA, USA (6 Jun 1977).

In 8th international laser radar conference. Invited papers.

This introduction to the use of lidar in air pollution applications is mainly concerned with its capability to detect and monitor atmospheric particulates by elastic backscattering. Even when quite imperceptible to the eye, such particulates may be detected at ranges of several kilometers even by lidars of modest performance. This capability is valuable in connection with air pollution in the following ways: by mapping and tracking inhomogeneities in particulate concentration, atmospheric structure and motion may be monitored; measurements of the optical properties of the atmosphere provide an indication of turbidity or of particulate number or mass concentrations; and the capability of obtaining at a single point return signals from remote atmospheric volumes makes it possible to make range-resolved measurements of gaseous concentration along the path by using the resonant absorption of energy of appropriate wavelengths.

6531 (CONF-7706131—, pp 22p, Paper 3) **Absorption spectroscopy applied to lidar atmospheric probing.** Hinkley, E.D. (Laser Analytics, Inc., Lexington, MA). 1977.

From 8. international laser radar conference; Philadelphia, PA, USA (6 Jun 1977).

In 8th international laser radar conference. Invited papers.

Sensitive remote detection of atmospheric pollutant gases can be achieved with optical systems based on the principle of differential absorption of tunable laser radiation. Using a broad definition of lidar, they may be classified as active bistatic, active monostatic, or passive monostatic, depending on their mode of operation. This paper is a survey of lidar systems based upon absorption spectroscopy and their operational characteristics. It describes differences in applications and the type of monitoring information which can be obtained from each.

6532 (CONF-7706131—, pp 22p, Paper 4) **Effect of multiple scattering on lidar measurements.** Cohen, A. (Hebrew Univ., Jerusalem). 1977.

From 8. international laser radar conference; Philadelphia, PA, USA (6 Jun 1977).

In 8th international laser radar conference. Invited papers.

The lidar equation in its standard form involves the assumption that the scattered irradiance reaching the lidar receiver has been only singly scattered. However, in the cases of scattering from clouds and thick aerosol layers, it is shown that multiple scattering cannot be neglected. An experimental method for the detection of multiple scattering by depolarization measurement techniques is discussed. One method of theoretical calculations of double-scattering is presented and discussed.

6533 (CONF-7706131—, pp 25p, Paper 5) **Problems in characterizing atmospheric aerosols by lidar alone.** Holland, A.C. (Wallops Flight Center, Wallops Island, VA). 1977.

From 8. international laser radar conference; Philadelphia, PA, USA (6 Jun 1977).

In 8th international laser radar conference. Invited papers.

In this paper the scattering properties of real atmospheric aerosols as they relate to laser radar measurements are reviewed. Theoretical approximations for modelling lidar experiments and laboratory measurements for characterizing real aerosols are discussed. In the first category the Mueller algebra and Stokes vectors; approximations for the single scattering properties of various aerosols; the information content of the Mueller or scattering matrix and related limitations of lidar measurements; and the effects of multiple scattering on lidar returns are reviewed. In the second category polar nephelometers; calibration procedures for nephelometers; and characterization of the scattering medium are reviewed. The outstanding problems in measuring the atmospheric aerosols by lidar alone are summarized.

6534 (CONF-7706131—, pp 28p, Paper 6) **Use of lidar for stratospheric measurements.** McCormick, M.P. (Langley Research Center, Hampton, VA). 1977.

From 8. international laser radar conference; Philadelphia, PA, USA (6 Jun 1977).

In 8th international laser radar conference. Invited papers.

This paper reviews stratospheric measurements possible with ground-based airborne, and satellite-borne lidar systems. The instruments, basic equations, and formats normally used for various scattering and absorption phenomena measurements are presented including a discussion of elastic, resonance, Raman, and fluorescence scattering techniques.

6535 (CONF-7706131—(Absts.)) **8th international laser radar conference. Conference abstracts.** (Drexel Univ., Philadelphia, PA (USA)). 1977. 196p. American Meteorological Society, Boston, MA.

From 8. international laser radar conference; Philadelphia, PA, USA (6 Jun 1977).

Abstracts are included for 93 papers presented at the 8th International Laser Radar Conference.

6536 (COO—2988-10) **Determination of sulfur speciation in industrial aerosols in an SO_2 rich environment. Progress report, 15 June 1977—14 June 1978.** Eatough, D.J. (Brigham Young Univ.,

Provo, UT (USA). Thermochemical Inst.). Mar 1978. Contract EY-76-S-02-2988. 21p. Dep. NTIS, PC A02/MF A01.

Recent epidemiological and toxicological studies have suggested that sulfur components of aerosols may present a serious health hazard. The chemistry, transformation, and stability of various sulfur oxidation states in aerosols produced by point sources emitting SO2 and aerosols is presently not well understood. The research being conducted under this contract is designed to identify concentrations of sulfite, sulfate, trace metals, and nitrite species in particulates produced by smelting and fossil fuel industries, establish the conditions (metal content, fuel type, SO_2 levels, acidity, temperature, humidity) and mechanism(s) of sulfite formation and study the stability of the various sulfur species in the ambient atmosphere. Research completed to date has resulted in the development of techniques for the above listed speciation problems and for the speciation of acid components of aerosols. Studies have been conducted to determine the ambient rate of oxidation or formation of metal-sulfite and organic-sulfite complexes in a copper smelter and a steel mill plume. Similar studies in the plume of a coal-fired generating station were inconclusive due to sampling problems.

6537 (EPA—450/3-77-015) **Addendum to the user's guide for the climatological dispersion model.** Brubaker, K.L.; Brown, P.; Cirillo, R.R. (Argonne National Lab., IL (USA)). May 1977. Contract W-31-109-ENG-38. 134p. Dep. NTIS, MF A01.

Portions of document are illegible.

The Climatological Dispersion Model (CDM) has been widely used in the development of air pollution control programs. However, users have been hampered in some instances by the lack of several peripheral routines and printouts. These include: a source contribution table; internal calibration; and statistical conversion of averaging times. The addition of these routines and printouts is straightforward, except for the area source contribution table. Due to the mathematical treatment of area sources in CDM, it is computationally difficult to create such a table. However, a satisfactory method was recently developed. It then became desirable to implement at one time all the peripheral routines and printouts noted above. These additions to CDM are documented in this report as an addendum to the CDM user's guide. This report, however, cannot stand alone; it only supplements the original user's guide. The computer program which contains the peripheral routines and printouts is designated CDMQC. This computer code provides pollutant concentration estimates which are essentially the same as those given by the original CDM code. However, major revisions and additions to the original code have been necessary so as to incorporate the new routines and printouts. CDMQC is available as part of the UNAMAP series of computer programs.

6538 (SAND—77-2120C) **Description and operation of two instruments for continuously detecting airborne contaminant vapors.** Cuthrell, R.E. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 18p. (CONF-780907—1). Dep. NTIS, PC A02/MF A01.

From 4. conference on contamination; Washington, DC, USA (10 Sep 1978).

Although particulate contaminant levels are well controlled and monitored in many industrial environments, the presence of organic vapor contaminants is usually ignored. These may inhibit thermocompression bonding of electrical lead wires, decrease the adhesion of metallizations, poison electroplating baths, and increase the resistance of electrical switches through frictional polymer formation. In this paper, the principles of operation and use of a tin oxide vapor detector and of a gold-gold adhesion detector for monitoring airborne organic contaminant levels are described. The former instrument is sensitive to any oxidizable vapor, whereas the latter detects primarily the higher molecular weight condensable gases. When used together, it is possible to distinguish between these two types of contamination. Both detectors sense nonspecific relative amounts of gaseous environmental pollutants and have been used to continuously monitor clean rooms, clean benches, and other production facilities where sensitive operations and assembly are performed.

6539 (UCRL—52473) **Total ozone retrieval from satellite multichannel filter radiometer measurements.** Lovill, J.E.; Sullivan, T.J.; Weichel, R.L.; Ellis, J.S.; Huebel, J.G.; Korver, J.; Weidhaas, P.P.; Phelps, F.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 May 1978. Contract W-7405-ENG-48. 106p. Dep. NTIS, PC A06/MF A01.

A total ozone retrieval model has been developed to process radiance data gathered by a satellite-mounted multichannel filter radiometer (MFR). Extensive effort went into theoretical radiative transfer modeling, a retrieval scheme was developed, and the technique was applied to the MFR radiance measurements. The high quality of the total ozone retrieval results was determined through comparisons with Dobson measurements. Included in the report are global total ozone maps for 20 days between May 12 and July 5, 1977. A comparison of MFR results for 13 days in June 1977 with Dobson spectrophotometer measurements of ozone for the same period showed good agreement: there was a root-mean-square difference of 6.2% (equivalent to 20.2 m.atm.cm). The estimated global total ozone value for June 1977 (296 m.atm.cm) was in good agreement with satellite backscatter ultraviolet data for June 1970 (304 m.atm.cm) and June 1971 (preliminary data--299 m.atm.cm).

6540 **Nitrous oxide: emission from soils during nitrification of fertilizer nitrogen.** *Science;* **199**: No. 4326, 295-296(20 Jan 1978).

Nitrous oxide is released from soils to the atmosphere during nitrification of ammonium and ammonium-producing fertilizers under aerobic conditions as well as by denitrification of nitrate under anaerobic conditions. Emissions of nitrous oxide during nitrification of fertilizer nitrogen may be significant in regard to the potential threat of fertilizer-derived nitrous oxide to the stratospheric ozone layer. Such emissions can be greatly reduced through the use of nitrapyrin, which inhibits nitrification of ammonium by soil microorganisms.

6541 **Dust measurement.** Courbon, P. *Ann. Mines;* **184**: No. 1-2, 31-38(Jan 1978). (In French).

This paper describes the behavior of dust particles in the air and in lungs, and reviews the techniques used in France for measurement of dust concentration in a gas stream, in a work place, and in the environment. Topics covered include Stokes law, sampling probes, isokinetic sampling, choice of sampling point, filters, measurement of respirable dust at fixed stations, personal dose measurement, and CPM 3 collector, automatic determination, the Tyndallometer and jetimeter, and sample analysis by beta-absorption.

6542 **Carbon dioxide and the 'greenhouse effect': an unresolved problem.** Smith, I. London; IEA Coal Research (1978). 40p. (ICTIS/ER—01).

This executive review evaluates current scientific literature concerned with the accumulation of carbon dioxide in the atmosphere. The extent and possible causes of natural variations in global climate are outlined as a background to potential variations due to human activity. Estimates are given on relative contributions of carbon dioxide to the atmosphere due to fossil fuel combustion, deforestation and other land modifications. The possibility of a rise in global temperature as a result of increasing the amount of carbon dioxide in the atmosphere is dicusssed including model predictions, natural factors which could compensate for or emphasize a warming effect, and the implications if extensive warming actually occurred. Carbon dioxide disposal is discussed, but there appears to be no practicable long-term means of accomplishing this. It is concluded that there is no evidence of a rise in global temperature due to carbon dioxide at present. Predictions, which involve a high degree of uncertainty, indicate that the global temperature could rise appreciably in the next century. An increase in precipitation rate is also expected. If these changes result in a redistribution of climatic zones, there may be problems in adapting agricultural belts in some regions. Complete melting of all the ice sheets would take several millenia. A partial melting of continental ice sheets would not necessarily occur in view of the increase in precipitation rates, but if it did, there would be a rise in sea level of a few metres. Melting of the Arctic sea ice would affect climate, but not sea level.

6543 **Environmental pollutants: detection and measurement.** Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978). 512p. (CONF-7705138—).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Separate abstracts were prepared for the 23 papers presented at the conference. (HLW)

6544 **Air pollutant monitoring: or how to improve on an Ouija board.** Lodge, J.P. Jr. pp 7-18 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Recent developments in air pollutant monitoring equipment have provided, really for the first time, instruments of reasonable stability, precision, and for the most part specificity. However, this comfortable situation did not arise spontaneously, or without many false starts and evolutionary changes. Based on previous historical studies and personal reminiscence, it is instructive to trace the evolution of knowledge of air pollutants from the situation of the first several millennia of air pollution, during which the nature of air pollutants were obvious, through a period of utter confusion caused by the proliferation of new pollutants, to the present situation where, once again, the nature of air pollutants is becoming better understood. In parallel with this change, there have been interesting changes in pollution regulations, in control technology, and in research and monitoring.

6545 Analysis of atmospheric pollutants of possible importance in human carcinogenesis. Sawicki, E. (Environmental Protection Agency, Research Triangle Park, NC). pp 69-101 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Genotoxic properties and analytical methodologies of a large variety of inorganic and organic gases, vapors and particulates have been discussed. The relevance of this information to the human condition is examined. With the prime importance of mutagenesis in the key processes of life, knowledge about the chemical and radiation background of our environments has become an absolute necessity for our survival with grace. Any chemical or radiation which affects DNA could be expected to affect one or more of the various carcinogenic pathways in living tissue. These are some of the reasons for our intense interest in all genotoxic pollutants.

6546 Ultratrace metals analysis by electrothermal atomization atomic absorption: present technology and potential developments. Bancroft, M. (Celdat Design Associates, Rochester, NY). pp 121-133 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

The history of electrothermal atomization atomic absorption (ETAA) is briefly reviewed for background. Some principles of ETAA and its differences from more traditional flame AA are discussed to explain the advantages of this technique for ultratrace metals analysis. The present status of ETAA is also reviewed—ETAA is now routinely used for certain trace metals in a wide variety of samples. Some refractory elements (examples are V, Mo, Ba) are now readily analyzed, and there are a growing number of applications to solid samples and even indirect analysis of nonmetallics. Some recent advances in temperature and power control methods have greatly improved sensitivity and repeatability of analytical conditions. Likely future developments of ETAA are in enhanced sensitivity, applicability to an everwider variety of samples, and multielement determinations. Some of the author's research on substrate effects, fill gas effects, and speciation is discussed where applicable to the future of ETAA.

6547 Passive sampling of ambient and work place atmospheres by means of gas permeation. West, P.W. (Louisiana State Univ., Baton Rouge). pp 173-189 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Sampling is often the most critical and most difficult step in the analytical process. Passive sampling of atmospheres holds great promise in the study of ambient air and work place atmospheres. The permeation of gases through membranes has been introduced as a means for passive sample collection that provides both accuracy and convenience. The permeation technique has the advantage that it is realatively free from disturbing effects such as variations in temperature, humidity, movement and the presence of copollutants. Because no power is required the sampling units are small, light, convenient and essentially indestructible. Thus, permeation devices offer the ideal approach for personal monitors and fills a unique need for industrial hygiene studies.

6548 Continuous measurement of sulfur-containing aerosols by flame photometry: a laboratory study. Huntzicker, J.J.; Hoffman, R.S. (Oregon Graduate Center, Beaverton). pp 191-209 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Aerosols of H_2SO_4, $(NH_4)_2SO_4$, and Na_2SO_4 have been continuously measured in the laboratory with a sulfur-specific flame photometer. Separation of the aerosol sulfur from gaseous sulfur (SO_2 and H_2S) was achieved by a diffusion stripper upstream of the flame photometer. The stripper is a tube coated with a substance which adsorbs SO_2 and H_2S. These gases diffuse rapidly to the wall where they are scavenged, but particles with much lower diffusion coefficients are efficiently transmitted. The flame photometer responds to $(NH_4)_2SO_4$ as $[S]^{1.9}$ and to H_2SO_4 as $[S]^{1.6}$ where [S] is the sulfur concentration. Above 2 $\mu g(S)/m^3$ the response to $(NH_4)_2SO_4$ exceeded the H_2SO_4 response. An experiment involving signal averaging of the flame photometer output produced an order of magnitude improvement in the signal to noise ratio and indicated that a limit of detection of 0.5 $\mu g/m^3$ of sulfur (i.e., 1.5 $\mu g/m^3$ of SO_4^{-2}) or lower can be expected. When a heater was inserted upstream of the diffusion stripper, the response to H_2SO_4 decreased to zero between 70 and 135°C and to $(NH_4)_2SO_4$ between 140 and 220°C. These phenomena result from the conversion of the aerosol sulfur to H_2SO_4, SO_3, and SO_2 gases which are scavenged at the walls of the heater and the diffusion stripper. Both the characteristic H_2SO_4 and $(NH_4)_2SO_4$ thermal profiles were observed in a $H_2SO_4/(NH_4)_2SO_4$ aerosol more acidic than NH_4HSO_4.

6549 Tunable diode laser detection of air pollutants. Hinkley, E.D. (Laser Analytics, Inc., Lexington, MA). pp 211-220 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Tunable diode lasers can be tailored to emit coherent radiation over a wide portion of the infrared "fingerprint" region of the electromagnetic spectrum. This, coupled with relatively large absorption cross sections for many molecular species and high specificity have resulted in several important applications of these devices to gaseous pollutant detection. In addition to providing the fundamental spectroscopic data for a number of pollutants, diode lasers have been used for low-pressure sampling, in situ source monitoring, longpath ambient-air monitoring, and as tunable local oscillators for infrared heterodyne detection. There have been several recent developments in the capabilities of diode lasers for the detection of air pollutants, and these will be discussed.

6550 Methods of microprobe analysis. Heinrich, K.F.J. (Inst. for Materials Research, Washington, DC). pp 241-253 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Advantages of probe techniques in avoiding dangers of alteration or contamination are pointed out. Microprobe analysis is discussed with regard to standardization and classification of techniques according to the nature of the exciting agent and of the signal. Characteristics of probe techniques are discussed with regard to range of application, specificity, sensitivity, and accuracy. Comments are given on specific techniques such as x-ray diffraction, laser microprobes, x-ray fluorescence probes, electron probe microanalysis, electron diffraction, and others. (HLW)

6551 Analytical transmission electron microscopy and its application in environmental science. Beaman, D.R. (Dow Chemical Co., Midland, MI). pp 255-294 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

In a transmission electron microscope equipped with an energy dispersive spectrometer it is possible to obtain the high resolution morphology, crystal structure, and elemental composition of submicron particulates and unsupported thin films. A limitation of quantitative x-ray spatial resolution which is in the range of 200 to 1000A is imposed by elastic scattering of the incident electron beam. Smaller regions may be examined qualitatively. Quantitative accuracy and spatial resolution are degraded by the excitation of regions lying outside the perimeter of the primary electron beam and can only be optimized by recognition of the source of the excitation and appropriate electron column modifications. The quantitative accuracy is not well established, but limited results indicate that +-10% of the amount present can be expected when using relative sensitivity factors which may be experimentally measured and, in some cases, calculated. When using standards of known thickness and composition, better accuracy is attainable. It is sometimes necessary to correct the measured concentrations for absorption and secondary fluorescence effects, even in the case of apparently thin materials. The mass sensitivity is in the range of 10^{-17}-10^{-18} grams, and the minimum mass fraction detectable can be as low as 1 to 3 wt %. It has been possible to measure concentrations of asbestos fibers in environmental samples at the ppT-ppB level with a precision of +-30%.

6552 Electron energy loss spectroscopy: a new microanalytical technique. Isaacson, M. (Enrico Fermi Inst., Chicago). pp 295-315 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Even though electron energy loss spectroscopy as a means of microchemical analysis is being pursued throughout the world, it is still in an extremely primitive state. At present, it certainly can't be thought of as a quantitative technique. However, since it can be easily coupled to microscopy at the 10A spatial resolution level (and in some cases to single atom microscopy), it has the potential of

becoming a powerful microanalytical tool. There are several problems, at present, which will be solved in the near future. These are problems common to any new technique: one needs to design more optimum spectrometer microscope systems; one has to develop more software for reducing the data (background substraction, peak fitting, etc.) and more hardware for recording the data; and one wants to understand the physics of the background in order to optimize all instrumental (and specimen) parameters (and this requires more data). Most certainly ELS can be thought of as a complementary technique to x-ray emission analysis (and, in fact, there have been suggestions to reduce the background by detecting energy loss electrons in coincidence with emitted x-rays) both with regard to elemental detection and the fact that an electron spectrometer neatly fits beneath the specimen whereas the x-ray detectors are placed above it.

6553 Secondary ion mass spectrometry for particulate analysis. Newbury, D.E. (National Bureau of Standards, Washington, DC). pp 317-348 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

SIMS offers a number of interesting and potentially powerful capabilities for the analysis of individual particles. All elements can be detected, with sensitivities frequently in the ppM range from micrometer sized areas. Quantitative analyses with a relative error less than a factor of two are feasible using relative elemental sensitivity factors. Analysis can frequently be confined to a near surface region, even in the microanalysis mode, and the determination of distributions in depth is possible. Molecular information is available, but the interpretation of the bonding state is ambiguous in the microanalysis mode. Images showing the lateral distribution of elements can be obtained.

6554 Surface chemical analysis of particles by Auger electron spectroscopy and ESCA. Lindfors, P.A.; Hovland, C.T. (Physical Electronics Industries, Inc., Eden Prairie, MN). pp 349-363 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

The basic phenomena of Auger electron spectroscopy (AES) and ESCA (electron spectroscopy for chemical analysis, also called XPS; x-ray photoelectron spectroscopy) are described. These surface sensitive (a few atomic layers) analytical methods were used to study flyash samples from the inlet and outlet of an electrostatic precipitator. AES results from the inlet particles indicated uniformity and a surface layer (approximately 20A thick) rich in Na and K. AES results from the outlet sample indicated two types of particles. One was similar to the input particles. A second was rich in Ca and C relative to the other particles. ESCA results from both inlet and outlet samples indicated a surface layer (approximately 10A thick) rich in Na, K and C.

6555 Size measurement of airborne particulates by time-of-flight spectroscopy. Dahneke, B. (Univ. of Rochester, NY). pp 367-393 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

The use of time-of-flight spectroscopy for measuring the aerodynamic size distribution of airborne particulates expanded into an aerosol beam in a vacuum environment is described. Results obtained using two different prototype models are presented. Both of these instruments use scattered light signals generated by the passage of a sample particle through one or two focused laser beams to detect and measure the particles. Although convenient to use for larger particles, the intensity of the scattered light signals depends very strongly on particle size so that particles smaller than about 0.1 μm diameter cannot be detected and measured. The detection of sample particles by electron beam scattering is considered in detail. By use of this detection method, it seems possible to extend the range of measurable particle size to an order of magnitude smaller.

6556 Continuous mass spectrometric analysis of environmental pollutants using surface ionization. Davis, W.D. (General Electric Co., Schenectady, NY). pp 395-411 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

An instrument for real-time analysis of trace impurities in air, including particulates was constructed and evaluated. The sampling system impinges a beam of particles and air on a heated Re ribbon and the resulting ions analyzed in a 7.6 cm radius magnetic sector mass spectrometer. Oxygen in the air raises the work function of the Re to about 7.2 eV at 1,000°K allowing analysis of elements and compounds with ionization potentials as high as 8 eV. For some low ionization potential elements, particles containing 1,000 atoms, particle concentrations of less than 1 per cm^3 and average concentrations of 10^{-12}—10^{-13} g/m^3 can be detected. Organic compounds can have ionization efficiencies as high as 20% and can be detected in concentrations as low as 0.001 ppB. Water is analyzed by forming an aerosol. Alkali metals and other easily ionized metals can be detected at concentrations of 10^{-13} g/cm^3 of water.

6557 Observation of the Raman effect from small, single particles: its use in the chemical identification of airborne particulates. Etz, E.S. (National Bureau of Standards, Washington, DC); Rosasco, G.J.; Blaha, J.J. pp 413-456 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

A Raman microprobe developed at the NBS is used to observe the normal Raman effect from single microparticles of size 1 μm and larger. The resulting spectra of the Raman-scattered light are characteristic of molecular and crystal vibrations in the solid and are the basis for the qualitative identification of major molecular constituents. Particles composed of a broad range of compounds exhibit vibrational Raman spectra and thus can be identified spectroscopically by comparison with spectra obtained from known particles or by reference to Raman data available for bulk samples. The application of Raman spectroscopy to the analysis of small, single particles thereby offers the opportunity for the determination of the chemical states of major elements. This capability for the speciation of principal molecular components is not available from other microprobe techniques which furnish elemental composition data only.

6558 X-ray analysis of environmental pollutants. Cahill, T.A. (Univ. of California, Davis). pp 457-465 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Excitation of characteristic x-rays by electrons, photons, or fast ion beams provides a method of elemental analysis characterized as quantitative, multielement, and nondestructive. Methods of excitation, selection of target configuration, and methods of x-ray detection all lead to diverse optimizations of analytical performance, allowing these methods to be used in a large variety of environmental problems.

6559 Modern techniques of activation analysis for the measurement of environmental trace metals. Filby, R.H.; Shah, K.R. (Washington State Univ., Pullman). pp 467-490 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

The principles of neutron activation, nuclear track, photon activation, and charged particle activation methods are discussed. The application of these techniques to the determination of trace elements in environmental materials is reviewed and recent developments in nuclear methods of environmental trace analysis are illustrated by several examples. The uses of nuclear activation methods in air pollution studies, water pollution studies, and energy production emissions are taken as specific examples of recent work. Reference is made to the accuracy and precision of nuclear activation methods and the need for environmental trace element standards.

6560 Has man increased stratospheric ozone. Ellsaesser, H.W. (Univ. of California, Livermore). *Nature (London);* **270**: No. 5638, 592(15 Dec 1977).

Many anthropogenic threats to the ozone layer have surfaced. It is suggested that agricultural modifications to the Earth such as increased oxygenation, drainage and pH of the soil and destruction of bacteria culturing humus, are more important than additions of fixed nitrogen in modifying N_2O production by denitrifying bacteria. Ozone measurements indicate that total global ozone has been increasing since measurements were first made in th early 1920's.

6561 Numerical model for long-distance transport of sulphur dioxide. Vel'tishcheva, N.S. *Meteorol. Gidrol.;* No. 9, 40-45(Sep 1977). (In Russian).

Basic principles for modeling the transport of contaminants at a distance of 1500 to 2000 m are described. By estimating terms of the equation main factors affecting this process are selected: advective transport, vertical exchange, washout by precipitation and removal due to chemical reactions. A technical description of the model is given. Results from estimating the real transport of sulfur

dioxide over the Western Europe are demonstrated. In conclusion, considerations on ways for improving the model are reported.

6562 Carbon dioxide and future climate. Mitchell, J.M. *Environ. Data Serv.;* 3-9(Mar 1977).

The addition of carbon dioxide to the atmosphere due to burning fossil fuel is discussed. The release rate of carbon dioxide has been growing since at least 1950 at an average rate of 4.3% per year. If all known fossil fuel reserves in the world are consumed, a total of between 5 and 14 times the present amount of carbon dioxide in the atmosphere will be released. The oceans would then be unlikely to withdraw the proportion of perhaps 40% which they are believed to have withdrawn up to the present. The increase in the atmosphere would be in excess of 3 times or conceivably ten times the present amount. If the reserves are used up within a few hundred years, more than half the excess carbon dioxide would remain in the atmosphere after a thousand years. The "greenhouse" effect of carbon dioxide is explained. The simulation with numerical models of the effects of carbon dioxide on atmospheric radiation fluxes is discussed. An estimated increase in the average annual temperature of the earth of 2.4 to 2.9C is given for doubling the carbon dioxide content; also a 7% increase in global average precipitation. The effect of increasing carbon dioxide on global mean temperature is viewed in the perspective of the glacial-interglacial cycles. The warming effect of carbon dioxide may induce a "super-interglacial" on the present interglacial which is expected to decline toward a new ice age in the next several thousand years. Finally it is proposed that it may be necessary to phase out the use of fossil fuels before all the knowledge is acquired which would necessitate such an action.

6563 Radiative-convective model study of the carbon dioxide climate problem. Augustsson, T.; Ramanathan, V. *J. Atmos. Sci.;* **34**: No. 3, 448-451(Mar 1977).

A radiative-convective model study of the increase in global surface temperature due to an increase in the carbon dioxide concentration is presented. The model considers several weak bands of carbon dioxide which contribute about 30% to the temperature increase. A comparison study of the various published results with the present analysis indicates that, for the carbon dioxide bands in the 12 to 18 micrometer region, the best estimate of temperature increase for the constant cloud top radiative-convective model is about 1.9K for a doubling of the carbon dioxide concentration. The inclusion of the carbon dioxide bands in the 10 and 7.6 micrometer regions increases the temperature to about 2K. The computed temperature increase is very sensitive to the radiative-convective model assumptions regarding cloud top and relative humidity. Because of this sensitivity the estimated value of temperature increase with concentration ranges fom 1.98 to 3.2K.

6564 Nature and origins of visibility-reducing aerosols in the Los Angeles air basin. White, W.H.; Roberts, P.T. (California Inst. of Tech., Pasadena). *Atmos. Environ.;* **11**: No. 9, 803-812(1977).

Simultaneous measurements of the light-scattering coefficient and chemical composition of ambient aerosols were made during selected smog episodes in the Los Angeles air basin. These data are statistically analyzed to determine the effective scattering efficiencies of the major secondary aerosol species. The individual scattering efficiencies are then used to estimate the contributions of major sources of reactive gases to the reduction of visibility in Los Angeles. Sulfate and nitrate compounds appear to have scattered more light at a given mass concentration than did other chemical fractions of the aerosol. The observed relationship of SO_2 and NO/sub x/ concentrations to the concentrations of tracers for major source types was consistent with existing inventories of SO_2 and NO/sub x/ emissions in the basin. Because of the high scattering efficiency of sulfates, the estimated contribution of large stationary sources of SO_2 to the reduction of visibility was comparable with that of the automobile.

6565 Investigation of long-range transport of ozone across the midwestern and eastern United States. Wolff, G.T. (Interstate Sanitation Commission, New York); Lioy, P.J.; Wight, G.D.; Meyers, R.E.; Cederwall, R.T. *Atmos. Environ.;* **11**: No. 9, 797-802(1977).

Long-range transport of ozone across the midwestern and eastern U.S. was investigated by analyzing daily ozone isopleth maps and comparing them to meteorological maps and air parcel trajectories for the period April 12-23, 1976. This period was characterized by the presence of a large high pressure system which produced widespread ozone concentrations of greater than 0.08 ppM as well as record-breaking maximum springtime temperatures over much of the study area. Daily maximum ozone values from the state networks were used to produce the daily ozone maps. Movement of areas of high ozone concentrations corresponded to the movement of the high pressure system. Actual transport across these areas is supported by trajectory analysis. Daily visibility maps were also prepared and they suggest that areas of low visibility generally coincide with areas of elevated ozone under certain conditions.

6566 Validation of a multiple source Gaussian air quality model. Prahm, L.P.; Christensen, M. (Danish Meteorological Inst., Copenhagen). *Atmos. Environ.;* **11**: No. 9, 791-795(1977).

A multiple source stationary Gaussian atmospheric dispersion model is tested in the Copenhagen area for 20 dispersion and decay parameter combinations, using different parameters for high and low sources. Optimal correspondance between measured and computed SO_2 values is obtained for parameters, representing rapid dispersion and decay. Use of different dispersion parameters does not change the spatial correlation coefficient between measured and computed concentrations significantly, but changes the slope of the regression line. The spatial correlation for 22 receptor points between the climatological SO_2 average concentration through a period of three months gives a correlation coefficient r larger than 0.9, explaining more than 80% of the variation. The slope of the regression line is between 0.9 and 1.0 for optimal dispersion parameter combinations. The model is found to be an applicable tool for urban planning and establishment of air quality strategies.

6567 Reaction of sulfur dioxide with ozone in water and its possible atmospheric significance. Erickson, R.E.; Yates, L.M.; Clark, R.L.; McEwen, D. (Univ. of Montana, Missoula). *Atmos. Environ.;* **11**: No. 9, 813-817(1977).

The rate of the reaction between ozone and dissolved sulfur dioxide is strongly pH dependent. This is so because sulfite ion reacts extremely rapidly (second order rate constant four orders of magnitude higher than that of bisulfite ion). These results suggest that under some conditions, atmospheric oxidation of sulfur dioxide may involve ozone.

6568 Flame ionization detector. Karas, E.L.; Lincourt, P.J.; Callahan, J.P.; Whitamore, E.E. (to The Foxboro Co.). US Patent 3,984,205. 5 Oct 1976. Filed date 10 Sep 1975. 10p.

A flame ionization detector adapted for use in hazardous areas and for mounting in any attitude, capable of using as small a flame as can be dependably maintained because of an arrangement of the flame at the open end of a thin-walled small diameter tubular electrode inside a relatively long open ended cylindrical collector and the regulation of the rates of flows which make it possible to maximize the sensitivity of the detector to the presence of an organic vapor. Excess air is maintained at a predetermined minimum. The inside diameter of the collector is made approximately twice the visible diameter of the widest point of the flame. A curtain of air flowing at a predetermined rate through the annular passage between the electrode and collector is directed into encompassing contact with the flame and the proximity of the collector to the flame maintains a relatively dense ion bearing layer of gases at the surface of the collector. A catalytic ignitor is provided with an externally operated manual switch for cleaning the ignitor.

6569 Possible use of the isotopic composition of rainwater. Cortecci, G. (Univ., Pisa, Italy). *Boll. Geofis. Teor. Appl.;* **19**: No. 69, 11-23(Mar 1976). (In Italian).

The possible use of the isotopic composition of rainwater and surface and underground water sulfates to trace air and water pollution is discussed. The isotopic and chemical analyses of rainwater sulfates collected in Pisa from August 1968 till July 1969 show that the sulfate is formed mainly by oxidation of sulfurous compounds introduced in the atmosphere by industrial activity and by domestic heating. The sea water sulfate contribution is generally small with values from 0 to 42%, as the yearly weighted mean is 15%. The sea sulfate contribution to the rainwater sulfate results closely related to the frequency and speed of the winds blowing from SSW. The delta ^{34}S values of the analyzed rainwater sulfates range from -2.5% to +7.0% relative to Canyon Diablo meteoritic troilite with a ^{34}S depletion from 13 to 23% relative to the sea water sulfate (+20.0%), the yearly weighted average value is +1.0%. The delta $^{18}O(SO_4^{2-})$ values range from +6 and +18% relative to SMOW, with a yearly weighted average value of +11.7%, in agreement with the estimated one of +11.9%. The monthly weighted average delta ^{18}L (SO_4^{2-}) values show a rather good positive correlation with the delta $^{18}(H_2O)$ ones. The rainwater sulfates show concentrations from 1 mg/1 to 12 mg/1, with a yearly weighted average value of 3.5 mg/1. The amount of atmospheric sulfate washed away rises in autumn and winter (with a maximum in January) and decreases in spring and summer. The possible isotopic effects on the sulfate naturally present in surface and underground water due to industrial discharges are also discussed.

6570 Sensing presence of fire. Horvath, Z.; Purt, G. (to Cerberus AG). US Patent 3,922,656. 25 Nov 1975. Priority date 6 Dec 1972, Switzerland. 8p.

Both the spectral absorption characteristic of air to test for gaseous combustion products, and the dispersion characteristics of atmosphere, to test for particulate matter, aerosols, smoke, and the like therin, are analyzed, and if there is coincidence of presence of carbon monoxide, and/or carbon dioxide, as well as dispersion of light, an alarm signal is generated. The light source is preferably a

light emitting diode, such as a tri-metal laser diode so that the radiation is in the spectral region in which absorption bands of gaseous combustion products can be sensed. The same light source may be utilized to also illuminate the atmosphere to test for particulate matter.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6521, 6598

6571 (ATDL—77/23, pp 42-158) **Comprehensive atmospheric transport and diffusion model.** Culkowski, W.M.; Patterson, M.R. (Oak Ridge National Lab., TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

A comprehensive version of the Atmospheric Transport Model is described that includes the effect of aerodynamic roughness on dispersion constants, clarifies the roles of the terinal velocity and deposition velocity, incorporates a tilting plume for heavy particulates, and includes an episodic calculation of exposure maxima. This model also limits the maximum value of the dispersion constants in order to retain the emitted material in the planetary boundary later. The structure of the program has been modularized in order to clarify the flow of calculation and allow more flexibility. Values for atmospheric concentration as well as both wetfall and dryfall deposition are calculated. The model is applied to the vicinity of three power plants, and correlations between model predictions and observed values are presented.

6572 (ATDL—77/23, pp 159-175) **Local and global transport and dispersion of airborne effluents.** Hanna, S.R. Sep 1977.

In Environmental Research Laboratories 1976 annual report.

At many air pollution sources, such as nuclear reactor buildings or reprocessing plants, the material is not released from a tall stack but is released from vents or small stacks. In this case the pollutant is often mixed into the turbulent wake downwind of the building, and conventional plume rise and diffusion formulas are not valid. During the past three years several wind tunnel and field tests of this phenomenon have taken place and a model of mixing in the wake was developed. For conventional sources, where the cross-wind distribution of pollutant concentrations is Gaussian, recommendations for the graphical and anaytical techniques which give the best results are discussed. The special problem of short range dispersion under stable, light-wind conditions has been studied by means of several experiments, and the results summarized. The many transformation processes which act on pollutant diffusion at all scales are reviewed.

6573 (DP—1509) **Calculation of particulate dispersion in a design-basis tornadic storm from Westinghouse PFDL, Cheswick, Pennsylvania.** Pepper, D.W. (Savannah River Ecology Lab., Aiken, SC (USA)). Jul 1978. Contract EY-76-C-09-0001. 27p. Dep. NTIS, PC A03/MF A01.

A three-dimensional numerical model is used to calculate ground-level air concentration and deposition (due to precipitation scavenging) after a hypothetical tornado strike at the Westinghouse Plutonium Fuel Development Laboratory (PFDL) at Cheswick, Pennsylvania. Plutonium particles less than 20 μm in diameter are assumed to be lifted into the tornadic storm cell by the vortex. The rotational characteristics of the tornadic storm are embedded within the larger mesoscale flow of the storm system. The design-basis translational wind values are based on probabilities associated with existing records of tornado strikes in the vicinity of the plant site. Turbulence exchange coefficients are based on empirical values deduced from experimental data in severe storms and from theoretical assumptions obtained from the literature. The method of moments is used to incorporate subgrid-scale resolution of the concentration within a grid cell volume. This method is a quasi-Lagrangian scheme which minimizes numerical error associated with advection. In all case studies, the effects of updrafts and downdrafts, coupled with scavenging of the particulates by precipitation, account for most of the material being deposited within 20-45 km downwind of the plant site. Ground-level isopleths in the x-y plane show that most of the material is deposited behind and slightly to the left of the centerline trajectory of the storm. Approximately 5% of the material is dispersed into the stratosphere and anvil section of the storm.

6574 (EML—344) **Environmental Measurements Laboratory environmental quarterly, June 1—September 1, 1978.** Hardy, E.P. Jr. (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Oct 1978. 76p. Dep. NTIS, PC A05/MF A01.

This report presents current information from the EML environmental programs and the National Radiation Laboratory of the New Zealand Department of Health. The initial section consists of interpretive reports and notes on strontium-90 concentrations in human bone specimens from New York City and San Francisco and the worldwide deposition of strontium-90 through 1977. Subsequent sections include tabulations of radionuclide and trace metal concentrations in surface air and strontium-90 in deposition, milk, diet, and tap water.

6575 (EML—344(App.)) **Environmental Measurements Laboratory environmental quarterly.** (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Oct 1978. 219p. Dep. NTIS, PC A10/MF A01.

Tabulated data are presented on fallout ^{90}Sr deposition at world land sites, ^{90}Sr content in samples of milk and drinking water from various locations, and the content of radionuclides and stable Pb in samples of surface air.

6576 (PNL—2500(Pt.3), pp 2.44-2.48) **Plutonium concentrations in forest fire smoke plumes.** Sehmel, G.A.; Orgill, M.M. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

Air filter samples from four forest logging slash burns were analyzed for plutonium. Although airborne concentrations were low, one fire definitely released fallout plutonium since the measured concentration in the smoke was one order of magnitude greater than ambient background measured upwind the same day.

6577 (SLAC—201) **Annual environmental monitoring report, January—December 1976.** (Stanford Linear Accelerator Center, CA (USA)). May 1977. Contract EY-76-C-03-0515. 33p. Dep. NTIS, PC A03/MF A01.

Environmental monitoring results continue to demonstrate that, except for penetrating radiation, environmental radiological impact due to SLAC operation is not distinguishable from natural environmental sources. During 1976 the maximum neutron dose near the site boundary was 3.4 mrem. This represents about 3.4% of the annual dose from natural sources at this elevation and 0.68% of the technical standard of 500 mrem per person annually. There have been no measurable increases in radioactivity in ground water attributable to SLAC operations. Airborne radioactivity released from SLAC also continues to make only a negligible environmental impact and result in a site boundary annual dose of less than 0.01 mrem, which represents less than 0.01% of the annual dose from the natural radiation environment and about 0.002% of the technical standard.

6578 (STI/PUB—466) **Monitoring of radioactive effluents from nuclear facilities. Proceedings Series.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1978. 610p. (In several languages). (CONF-770916—). IAEA $50.00.

From International symposium on the monitoring of radioactive airborne and liquid releases from nuclear facilities; Portoroz, Yugoslavia (5 Sep 1977).

The following topics are discussed: aims and design of monitoring programs for planned and unplanned releases; monitoring procedures for airborne and liquid releases; special techniques; recording and reporting of monitoring results; and national requirements, practices and experiences. Individual papers are included separately. (HLW)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6509, 6647

6579 (ATDL—77/23, pp 239-244) **Observed and predicted cooling tower plume rise at the John E. Amos Power Plant, West Virginia.** Hanna, S.R. Sep 1977.

In Environmental Research Laboratories 1976 annual report.

There is much current interest in cooling tower plume rise because of its importance in determining the environmental impact of cooling towers at planned power plants and industrial facilities. Some of the possible environmental problems related to heat and water emissions from cooling towers are drift deposition, ground level fog, cloud formation, and precipitation enhancement. An important factor in all of these problems is the calculation of the plume trajectory, which is often complicated by the presence of multiple sources and water phase changes in the plume. The latent heat does not strongly influence plume rise if there is no cloud present at the top of the plume. A one dimensional plume and cloud growth model was developed to study these effects. In this paper, the predictions of the model are compared with observations of cooling tower plume rise at the John E. Amos, W. Va. fossil-fuel power plant.

6580 (ATDL—77/23, pp 351-457) **First annual report on weather modification effects of cooling towers.** Hanna, S.R.; Hosker,

R.P. Jr. (Air Resources Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

Single cooling towers emit as much as 1000 MW of sensible and latent heat to the atmosphere. Planned energy centers or power parks may contain clusters of cooling towers which emit a total of 100,000 MW. Heat releases of this magnitude have the potential to significantly alter local weather. Cooling towers can also alter the local environment by the production of fog and clouds, and the deposition of drift salts. A basic one-dimensional mathematical model is presented for plume and cloud growth in the vicinity of cooling towers. Since the cooling tower emissions are usually constant with time, at least over time periods less than four or five hours, the steady-state assumption is good. Phenomena such as multiple plume merging and changes in the environmental air surrounding the plume are accounted for only by crude parameterization. Applications in analysis of the environmental effects of cooling towers at fossil-fuel and nuclear power plants are reported.

6581 (ATDL—77/23, pp 523-530) **Secondary motions in a cooling tower plume.** Hanna, S.R.; Pike, M. (Air Resources Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

Time-lapse photography was used to estimate the speed of the vortex in the condensed plume at the edge of a bank of mechanical draft cooling towers at the Oak Ridge Gaseous Diffusion Plant. At a distance of about 30 m from the towers, the median tangential speed is about 2 m/s in the downward direction.

6582 (ATDL—77/23, pp 563-595) **Hydrometeorological aspects of electric power production.** Hanna, S.R. (Air Resources Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

Observed atmospheric effects due to waste heat release from cooling towers and ponds are reviewed, including sun shading, ground fog, drift deposition, interference with aircraft, interactions with chemical plumes, high winds, and changes in cloudiness, temperature, and precipitation. It is seen that effects are generally minor from current power production facilities, but that more serious effects can be expected if large energy centers (10,000 MW and up) are built. The status of physical and mathematical modeling is summarized, and it is concluded that two or three dimensional second or third order closure models must be developed in order to assess the probability of vorticity concentration at large energy centers and adequately explain plume merging.

6583 (ATDL—77/23, pp 597-627) **Drift-modeling and monitoring comparisons.** Chen, N.C.J. (Oak Ridge National Lab., TN); Hanna, S.R. Sep 1977.

In Environmental Research Laboratories 1976 annual report.

Several drift deposition models for cooling towers are compared using a set of standard input conditions. The predicted maximum drift deposition differs by two orders of magnitude, and the downwind locations of the maximum differ by one order of magnitude. The discrepancies are attributed mainly to different assumptions in the models regarding the initial effective height of the droplets. Current programs in which drift characteristics at the tower mouth and drift deposition downwind of the tower are being measured are summarized. At the present time, drift deposition measurements, sufficiently comprehensive for model verifications, are unavailable. Hopefully, the Chalk Point Program will satisfy this need.

6584 (PNL—2500(Pt.3), pp 2.41-2.42) **Laboratory simulations of interactive plumes from mechanical draft cooling towers.** Kannberg, L.D. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

In connection with studies being conducted under the Meteorological Effects of Thermal Energy Releases (METER) Program, Pacific Northwest Laboratory (PNL) has been simulating discharges from physical models of mechanical draft cooling towers to determine the impact of various conditions in cooling tower plume mixing and trajectory. Analysis of the data suggests that siting cooling towers should be based on ambient wind history, plume dynamics, and tower operating conditions, and possibly on site terrain.

6585 (PNL—2500(Pt.3), pp 2.42-2.43) **Fire analog: a comparison between fire plumes and energy center cooling tower plumes.** Orgill, M.M. Feb 1978.

In Pacific Northwest Laboratory annual report for 1977 to the DOE Assistant Secretary for Environment. Part 3. Atmospheric sciences.

Thermal plumes or convection columns associated with large fires have been compared to thermal plumes from cooling tower systems to evaluate the fire analog concept. Energy release rate of mass fires is generally larger than that of single or small groups of cooling towers but may be comparable to proposed large energy centers. However, siginficant physical differences exist between cooling tower and fire plumes. Cooling tower plumes are usually dominated by ambient wind and turbulence conditions. Fire plumes, depending on fire intensity and area, can transform into free convection energy systems resulting in convective columns, strong inflow and updrafts, turbulence and concentrated vortices. Since these characteristics have not been observed with cooling tower plumes to date, the fire analog concept is questionable at this time. Additional research is needed on fire and cooling tower plumes.

REGULATIONS

REFER ALSO TO CITATION(S) 5728, 5729, 6544

ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 6506, 6507, 6508

BASIC STUDIES

REFER ALSO TO CITATION(S) 6509

6586 (ATDL—77/23, pp 177-236) **Forest meteorology research within the Oak Ridge site, eastern deciduous forest biome, USIBP.** Hutchison, B.A.; Matt, D.R. (Air Resources Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

The data presented here indicate that the diurnal trends in forest microclimate are dominated by the diurnal trend in incident solar radiation amounts and the diurnal changes in solar elevations. Absolute values of these microclimatic variables, on the other hand, reflect strongly, the synoptic climatic conditions present and, to a lesser degree, the interactions among synoptic climatic parameters, forest structure, forest physiology, and soil moisture conditions. The seasonal changes in forest microclimate are the result of changes in incident radiation amounts, earth-sun geometry, and phenological change in forest structure along with seasonal changes in synoptic climatic parameters. The temporal and spatial variations of solar radiation within and above a deciduous forest composed predominately of tulip poplar (biriodendron tulipifera) were documented and on attempt was made to relate the variations to forest structure.

6587 (ATDL—77/23, pp 327-337) **Annual cycle of solar radiation in a deciduous forest.** Hutchison, B.A.; Matt, D.R. (National Oceanic and Atmospheric Administration, Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

Periodic solar radiation measurements within and above an east Tennessee Liriodendron forest and continuous records of insolation from a nearby NOAA weather station were used to derive an approximation of the animal radiation regime within and above the deciduous forest. The interaction of changing solar elevations, insolation, and forest phenology are shown to control the radiation climate within the forest. Maximum radiation penetrates the forest in early spring as solar paths rise higher in the sky each day just prior to leaf expansion. After leaf expansion begins, average radiation received within the forest decreases rapidly despite continued increases in solar elevations and daily insolation. This forest attains full leaf in early June and from then until the advent of leaf abscission near the autumnal equinox, forest structure remains relatively static. Solar elevations and daily insolation decline following the summer solstice, however, and as a result, average radiation penetrating the forest slowly declines throughout the summer reaching an annual minimum in early autumn. With leaf fall, slightly increased amounts of radiation penetrate the forest but as within-forest solar paths continue to lengthen, radiation within the forest again declines. Minimum amounts of solar radiation penetrate the leafless forest around the winter solstice.

6588 (ATDL—77/23, pp 477-499) **Distribution of solar radiation within a deciduous forest.** Hutchison, B.A.; Matt, D.R. (National Oceanic and Atmospheric Administration, Oak Ridge, TN). Sep 1977.

In Environmental Research Laboratories 1976 annual report.

Solar radiation was measured within and above an east Tennessee deciduous forest over a 2-yr period. Diurnal patterns of within-forest radiation follow the temporal variation in incident

radiation but become more irregular with depth in the forest because of the highly variable penetration of beam radiation in space and in time. Seasonally, radiation in the forest increases substantially from winter to its annual maximum in early spring as solar elevations increase. Although solar elevations continue to rise each day until the summer solstice, amounts of total radiation and its beam component drop sharply in the forest with the advent of leaf expansion. Diffuse radiation in the forest continues to increase slowly following the onset of leaf expansion but reverses as the forest approches a fully leafed state. Following the summer solstice, forest structure remains essentially static until abscission while solar elevations decrease. In summer and early autumn, total radiation and both its beam and diffuse ocmponents decrease slowly in the forest to their annual minimum in autumn. With leaf abscission and subsequent fall, radiation increases slightly in the forest but soon declines again as solar elevations approach their annual minimum of the winter solstice.

6589 Multivariate perspectives on the ecology of plant mineral element composition. Garten, C.T. Jr. (Savannah River Ecology Lab., Aiken, SC). *Am. Nat.;* **112**: No. 985, 533-544(1978).

The mineral element composition of plants, being a multivariate phenotypic trait, reflects the genotypic and environmental interactions influencing chemical content, including those related to ecological niche. Multivariate discriminant analysis was used to describe the position and area of nine different plant species in an "elemental hyperspace" based on the mineral element composition of leaves. With the exception of woody species, there was considerable interspecific variation in elemental concentrations and distinct separation among species in the element space. Semiaquatic macrophytes were quite distinct in their mineral element composition. The region each species occupies in the element space presumably corresponds to an adaptive zone of mineral element concentrations that enable each species to survive in the environment. Some evidence presented indicates that phenotypic variation in mineral element composition in a species reflects niche size in the nutrient environment. Interelement correlations in concentrations across 110 plant species were explored using principal components analysis. Four principal components were extracted from a correlation matrix. The component structure was interpreted on the basis of biochemical functions of elements in cells. Principal component 1 was a nucleic acid-protein set correlated with concentrations of P, N, Cu, S, and Fe. Component 2 was a structural and photosynthetic set correlated with concentrations of Mg, Ca, and Mn. Component 3 was an enzymatic set correlated with concentrations of Mn, K, and Mg. Future research on the mineral element composition of different plant species might begin by considering these three hypothetical element sets.

6590 Analysis of an East Tennessee oak hickory forest by canonical correlation of species and environmental parameters. Kercher, J.R.; Goldstein, R.A. (Oak Ridge National Lab., TN). *Vegetatio;* **35**: No. 3, 153-163(1977).

The objectives of this study were: (1) to quantify the environment of the plant communities of the Walker Branch Watershed in Oak Ridge, TN; (2) to test the validity of the conclusions of Goldstein and Grigal about ecological conditions under which the plant communities exist; (3) to study the relative advantages and disadvantages of numerical classification and ordination of environmental data versus species data in characterizing community structure; and (4) to establish quantitatively the relationship between environmental conditions and community type. One of the long range problems being considered is how a perturbation which alters the abiotic environment affects community dynamics. A new multivariate analytical technique, canonical group correlation (CGC) is developed to correlate abiotic and biotic characterization of communities. A predictive model for successional development is constructed.

6591 Contributions of cryptozoa to forest nutrient cycles. McBrayer, J.F. pp 70-77 of Proceedings in life sciences: the role of arthropods in forest ecosystems. Mattson, W.J. (ed.). New York; Springer-Verlag Inc. (1977).

Satchell (1974), among others, has proposed that decomposer invertebrates may be important in regulating rates of elemental release in ecosystems where high precipitation, seasonal plant uptake, and low cation exchange capacity of soils can lead to serious leaching losses. Satchell indicated that the hypothesis would be difficult to prove and, in fact, it would be difficult to prove that the animals were not actually competing with vegetation for available ions. Nevertheless, decomposer organisms do exhibit significant elemental concentrations either above or below that of the plant litter substrate (Reichle, 1971). Further, abundant cations tend to be concentrated little, if at all, while critical elements which occur in anionic form in the soil solution, and are most susceptible to leaching losses, tend to be concentrated most. The following work examines the fluxes of seven elements, three of which are anionic in the soil solution, through a decomposer invertebrate food-web.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 6596, 6597

6592 (NVO—181, pp 147-158) **Comparison of in situ gamma soil analysis and soil sampling data for mapping ^{241}Am and ^{239}Pu soil concentrations at the Nevada Test Site.** Kirby, J.A. (Univ. of California, Livermore); Anspaugh, L.R.; Phelps, P.L.; Huckabay, G.W.; Markwell, F.R.; Barnes, M.G. Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Soil sampling and in situ ^{241}Am-gamma counting with an array of four high-purity, planar, Ge detectors are compared as means of determining soil concentration contours of plutonium and their associated uncertainties. Results of this survey, which covered an area of approximately 300,000 m^2, indicate that with one-third the number of sampling locations, the in situ gamma survey provided soil concentration contours with confidence intervals that were about one-third as wide as those obtained with soil sampling. The methods of the survey are described and a discussion of advantages and limitations of both methods is given.

6593 (NVO—181, pp 305-319) **Progress report on the documentation of the LFE soil dissolution procedure.** Wessman, R.A.; Curry, B.; Benz, M.; Leventhal, L. (LFE Environmental Analysis Labs., Richmond, CA). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

The LFE soil dissolution procedure has been in use since 1970 to routinely dissolve 1- to 10-gram soil samples and, occasionally, up to 100-gram samples. Radiochemical analyses can be performed on the dissolved sample. Hydrofluoric acid is added first, then HNO_3, H_3BO_3, and HCl are added successively and evaporated. Any undissolved residue is ashed and treated again. Some soils require treatment with NaOH to complete the dissolution. Various comparisons or tests of the procedure, in combination with Pu or Am analyses, have been made and are reviewed. Analyses for Pu of 10-gram spiked soil samples at this laboratory, using either the LFE procedure or the U.S. Nuclear Regulatory Guide, have produced equivalent results.

6594 (NVO—181, pp 321-329) **Comparison of two methods of dissolution for soil samples.** Lee, K.D.; Straight, R.J. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Soil as a matrix for plutonium and americium has been studied extensively, and several methods have been developed for dissolving these radionuclides in such a matrix. Two methods predominate for preparing Nevada Test Site Samples, viz., the HASL-LASL Leach Method and the LFE Total Dissolution Method. Recently a comparison study of both techniques was conducted at REECo to determine the relative effectiveness, simplicity, and cost for each using samples from nuclear and nonnuclear detonation sites. For ease of analysis, the Leach Method holds a slight advantage since it is essentially a single cycle version of the Total Dissolution procedure and does not require filtration of remaining residues or the use of a furnace. While differences in required facilities and equipment do not add up to a net advantage for either technique, the collected data indicate that both methods can be equally effective.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6540, 6543, 6560, 6590, 6640

6595 (BM-RI—8293) **Antimony, arsenic, and mercury in the combustible fraction of municipal solid waste.** Haynes, B.W.; McConnell, J.C.; Law, S.L. (Bureau of Mines, Washington, DC (USA)). 1978. 14p. Bureau of Mines, Washington, DC.

This research was conducted as part of the U.S. Department of the Interior, Bureau of Mines program to recover metals, glass, and a combustible fraction from municipal solid waste (MSW). The objective of this analytical study was to determine the concentration of antimony, arsenic, and mercury in samples taken from various sampling areas in the Bureau of Mines raw refuse recycling plant and to compare these values with those for coals used in the generation of electricity. To provide the necessary analytical data, sensitive reproducible ashing-chemical digestion-atomic absorption procedures were adapted from published procedures. It was determined that antimony and mercury concentrations in the combustible fraction of MSW are approximately an order of magnitude higher than

those found in coals presently used for power generation; the arsenic concentration is similar in both fuels.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6578

6596 (NVO—181, pp 41-52) **Particle-size problem in the assay of plutonium in field soil samples.** Wallace, A.; Romney, E.M. (Univ. of California, Los Angeles). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

The hot particle problem in plutonium-contaminated soil is believed to be associated with the nature of random particle distribution. One result is that either relatively large-sized samples or relatively large numbers of smaller samples are necessary in order to accurately assay the relatively low levels of radioactivity present. For cleanup levels now being recommended, using the best of known field monitoring support equipment available, practicality may dictate that sampling precision must be as low as +-100%. An estimate was made of sample sizes needed for given accuracy based on the number of Pu particles per sample. One conclusion is that a concentration level of ^{239}Pu in a very small sample aliquot is without practical meaning. It may record zero, but another aliquot from the same lot may have a high concentration. Variation in some field samples from the Nevada Test Site was determined by counting different samples for ^{241}Am inasmuch as this nuclide is commonly used for rapid field detection of plutonium. Results indicated that the ^{241}Am may not be present, at least in part, in particles. Rather, it was more uniformly distributed in the aged material involved. Information such as this has bearing on the practical aspects of cleaning up Pu-contaminated areas, especially to levels of a very few nCi/g soil or fractions of nCi/g soil.

6597 (NVO—181, pp 173-186) **Effect of pretreatment on the size distribution of plutonium in surface soil from Rocky Flats.** Tamura, T. (Oak Rige National Lab., TN). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

The particle size and plutonium distributions were evaluated using different dispersive pretreatments on a 0-5 cm surface soil sample from Rocky Flats. The four treatments in order to increasing severity consisted of: water only; ultrasonic treatment for 15 minutes at the soil pH; ultrasonic treatment of pH 9.5; and H_2O_2 (organic decomposition) digestion followed by ultrasonic treatment at pH 9.5. The water only treatment resulted in 60% of the plutonium activity to be in the coarse and medium silt fractions. With increasing severity, the contributions of these fractions decreased and the clay fraction increased. The fourth treatment resulted in 20% of the activity in the coarse and medium silt fractions, and 62% in the clay fraction. These results are compared with the findings of a surface sample from the safety shot area of the Nevada Test Site. At NTS, the treatments did not significantly affect the plutonium distribution which was predominantly in the coarse and medium silt fractions (75%).

6598 (NVO—181, pp 187-205) **Environmental plutonium levels near the Nevada Test Site.** Bliss, W.A.; Jakubowski, F.M. (Environmental Protection Agency, Las Vegas, NV). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

The Environmental Monitoring and Support Laboratory-Las Vegas is engaged in a study to define the distribution of plutonium in the environment surrounding the Nevada Test Site (NTS). Extensive soil sampling has been conducted around the NTS, both to define areal distribution and to investigate local concentrating effects by natural phenomena. Additionally, air filters used in the off-NTS air surveillance network as well as those collected in special studies have been analyzed for plutonium to better define ambient levels and to investigate the possibility of resuspension. Results of these, as well as other studies related to defining the ambient plutonium levels around the NTS, are given in this report.

6599 (NVO—181, pp 367-422) **Estimating total ^{239,240}Pu in blow-sand mounds of two safety-shot sites.** Gilbert, R.O. (Pacific Northwest Labs., Richland, WA); Essington, E.H. Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

A study for estimating the total amount (inventory) of ^{239,240}Pu in blow-sand mounds at two safety-shot sites (Area 13-Project 57 on the Nellis Air Force Base and Clean Slate 3 on the Tonopah Test Range in Nevada) is described. The total amount in blow-sand mounds at these two sites is estimated to be 5.8 +- 1.3 (total +- standard error) and 10.6 +- 2.5 curies, respectively. The total ^{239,240}Pu in mounds plus desert pavement areas, both to a depth of 5 cm below desert pavement level, is estimated to be 39 +- 5.7 curies at the Project 57 site and 36 +- 4.8 curies at Clean Slate 3. These estimates are compared with the somewhat higher estimates of 46 +- 9 and 37 +- 5.4 curies reported that pertain to only the top 5 cm of mounds and desert pavement. The possibility is discussed that these differences are due to sampling variability arising from the skewed nature of plutonium concentrations, particularly near ground zero.

6600 (NVO—181, pp 423-429) **Revised total amounts of ^{239,240}Pu in surface soil at safety-shot sites.** Gilbert, R.O. (Pacific Northwest Labs., Richland, WA). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Corrected estimates of ^{239,240}Pu in surface soil (0-5 cm) are given for 10 safety-shot sites on the Nevada Test Site, Tonopah Test Range, and Nellis Air Force Base. These adjustments result from using more accurate estimates for the sizes of americium activity strata than were originally reported. Revised estimates of ^{239,240}Pu inventory associated with vegetation are also given. The possibility of future changes in these inventory estimates as a result of new data is discussed.

6601 (NVO—181, pp 431-445) **New statistical tool, kriging, and some applications to Area 13 data.** Barnes, M.G. (Desert Research Inst., Las Vegas, NV); Delfiner, P.; Gilbert, R.O. Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Kriging is a relatively new statistical procedure which has proven in practice to be very realistic and to be less prone to unsatisfactory results than some common approaches. A very brief introduction to the theory behind kriging is presented, along with a discussion of the importance of considering scale when using this technique. A description is given of BLUEPACK, a computer program which performs kriging, and several examples illustrate some uses of kriging and the flexibility of the program.

SOIL

REFER ALSO TO CITATION(S) 5315

6602 (NVO—181) **Transuranics in desert ecosystems.** White, M.G.; Dunaway, P.B.; Wireman, D.L. (eds.). (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Nov 1977. 475p. (CONF-770369—). Dep. NTIS, PC A20/MF A01.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

Separate abstracts were prepared for 18 of the papers presented. Abstracts of three papers have appeared in ERA previously.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 6575, 6602, 6792

6603 (NVO—181, pp 1-15) **Incorporation of transuranics into vegetable and field crops grown at the Nevada Test Site.** Au, F.H.F.; Leavitt, V.D.; Beckert, W.F.; McFarlane, J.C. (Environmental Protection Agency, Las Vegas, NV). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Radish, lettuce, barley, and alfalfa plants were grown from seeds in undisturbed soil in Area 13 of the Nevada Test Site to determine the uptake of transuranics under field conditions. The plants were grown in small greenhouses erected over the soil to preclude aerial deposition of resuspended transuranics on the growing plants. The crops were irrigated during the growing season with either distilled water, diethylenetriaminepentaacetic acid (DTPA) in distilled water, fertilizer in distilled water, or a combination of DTPA and fertilizer in distilled water. The plutonium and americium contents of the harvested plants showed differences which are mostly attributable to the effects of the treatments and the resulting changes in soil pH during the experiment.

6604 (NVO—181, pp 207-219) **Plutonium concentrations and Pu/Am ratios in small vertebrates from NAEG Intensive Study Areas of NTS.** Bradley, W.G.; Moor, K.S.; Naegle, S.R. (Univ. of Nevada, Las Vegas). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Radioecological studies of small vertebrates in Pu-contaminated areas of NTS began in spring 1972 and have continued to date. Species conposition, relative abundance, and other pertinent ecological data have been presented in previous reports. In addition, data analysis of Pu and Am concentrations in selected rodent and lizard species has been presented for all NAEG Intensive Study Areas. This report provides further analysis of Pu concentration in small vertebrates of Areas 5 and 11, NTS.

6605 (NVO—181, pp 281-303) **Actinide concentrations in tissues from cattle grazing a contaminated range.** Smith, D.D.; Bernhardt, D.E. (Environmental Protection Agency, Las Vegas, NV). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Actinide concentrations in the tissues of beef animals periodically sacrificed and sampled during a 3-year grazing study on a plutonium-contaminated range of the Nevada Test Site are discussed. Actinide concentrations in the skeletons of the cows originally introduced into the study areas showed little increase with increased time of exposure, while those of animals born in the study areas showed a continued upward trend with time. Plutonium-239/americium-241 ratios in tissues and ingesta suggest little differentiation in the uptake of these radionuclides. However, the plutonium-239/plutonium-238 ratios indicate that plutonium-238 is more readily absorbed. The gonadal concentrations of the actinides were significantly higher than those of blood and muscle and approached those of bone. These data indicate that consideration should be given to the plutonium-239 dose to gonads as well as that to bone, liver, and lungs of man.

6606 (ORNL/EIS—127) **Nevada Applied Ecology Group publications.** White, M.G.; Pfuderer, H.A. (comps.). (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 186p. (NVO/AEIC—78/1). Dep. NTIS, PC A09/MF A01.

This bibliography serves as a guide to the environmental studies sponsored by the Nevada Applied Ecology Group (NAEG) at the Department of Energy Nevada Test Site nuclear weapons complex. The NAEG is part of the Nevada Operations Office of the United States Department of Energy. The references included in the bibliography reflect the interests of the NAEG (e.g., hazard evaluation of the nuclear safety-shot sites). The objectives of the NAEG plutonium studies at the Nevada Test Site were defined as follows: (1) delineate locations of contamination; (2) determine concentrations in ecosystem components; (3) quantify rates of movements among ecosystem components; (4) evaluate radiological hazards of plutonium; (5) identify areas which need to be cleaned up or treated; and (6) develop techniques for cleanup or treatment.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 5084, 5085, 5086, 5087, 5088, 5128, 6103

6607 (ARH-C—00014(Vol.1)) **Sample descriptions and summary logs of selected wells within the Hanford Reservation.** Summers, W.K.; Hanson, R.T. (Atlantic Richfield Hanford Co., Richland, WA (USA)). Jan 1977. Contract EY-76-C-06-2130. 294p. Dep. NTIS, PC A13/MF A01.

As part of a program aimed at quantifying the hydraulic parameters of the synthetic flow systems of the Hanford Reservation a systematic study was made of the samples from selected wells. This report presents the description and summary logs of cuttings samples from 114 wells and test holes drilled within the Hanford Reservation. Written descriptive matter as required, including color, fossils, trace constituents, total drilled depth, and any other nonstandard features observed is included.

6608 (ARH-C—00014(Vol.2)) **Sample descriptions and summary logs of selected wells within the Hanford Reservation.** Summers, W.K.; Hanson, R.T. (Atlantic Richfield Hanford Co., Richland, WA (USA)). Jan 1977. Contract EY-76-C-06-2130. 296p. Dep. NTIS, PC A13/MF A01.

This report presents the description and summary logs of cuttings samples from 114 wells and test holes drilled within the Hanford Reservation. Written descriptive matter as required, including color, fossils, trace constituents, total drilled depth, and any other nonstandard features observed is included.

6609 (ARH-C—00014(Vol.3)) **Sample descriptions and summary logs of selected wells within the Hanford Reservation.** Summers, W.K.; Hanson, R.T. (Atlantic Richfield Hanford Co., Richland, WA (USA)). Jan 1977. Contract EY-76-C-06-2130. 162p. Dep. NTIS, PC A08/MF A01.

This report presents the description and summary logs of cuttings samples from 114 wells and test holes drilled within the Hanford Reservation. Written descriptive matter is included as required, including color, fossils, trace constituents, total drilled depth, and any other nonstandard features observed.

6610 (ARH-C—00014(Vol.4)) **Sample descriptions and summary logs of selected wells within the Hanford Reservation.** Summers, W.K.; Hanson, R.T. (Atlantic Richfield Hanford Co., Richland, WA (USA)). Jan 1977. Contract EY-76-C-06-2130. 246p. Dep. NTIS, PC A11/MF A01.

This report presents the description and summary logs of cuttings samples from 114 wells and test holes drilled within the Hanford Reservation. Written descriptive matter as required including color, fossils, trace constituents, total drilled depth, and any other nonstandard features observed is included.

6611 (ARH-C—00016(Vol.1)) **Drillers' logs of wells in the Hanford reservation. Volume I.** Summers, W.K.; Schwab, G. (Atlantic Richfield Hanford Co., Richland, WA (USA)). Jan 1977. Contract EY-76-C-06-2130. 313p. Dep. NTIS, PC A13/MF A01.

More than 3000 wells and test holes have been drilled within the Hanford Reservation. Information on these wells range from complete sample suites complemented by bore hole geophysical studies to no record at all. Often the driller's log is the only record available for a well. This report is a product of the continuing project aimed at quantifying the hydraulic parameters of the synthetic flow system of the Hanford Reservation. The subsurface geology of the Hanford Reservation must be understood before the hydrologic parameters of the rocks can be estimated with any accuracy. To refine the state of our knowledge of the hydrologic regime all available data concerning the reservation geology must be considered and evaluated. Transcriptions are presented of 417 drillers' logs. This compilation includes every original driller's report we could obtain for the 600, 1100, and 3000 areas of the Hanford Reservation, but only a few logs from each of the 100, 200, and 300 areas where holes are very close together. The standard format consists of two parts: a heading that gives the general information for the well, and the description of the material penetrated.

6612 (ARH-C—00016(Vol.2)) **Drillers' logs of wells in the Hanford reservation. Volume II.** Summers, W.K.; Schwab, G. (Atlantic Richfield Hanford Co., Richland, WA (USA)). Jan 1977. Contract EY-76-C-06-2130. 212p. Dep. NTIS, PC A10/MF A01.

Transcribed drillers' logs, in the same order as presented in Hanford Wells, 1973, are included for some 200 wells. The geologic structures at various depths are recorded. Drillers' notes are included when they help define the character of the strata being drilled or the nature or quality of the samples taken.

6613 (RLO—2228-T3-5) **Establishment, succession, and stability of vegetation on surface mined lands in eastern Montana. Annual progress report, March 1, 1977—February 29, 1978.** Sindelar, B.W.; Plantenberg, P.L. (Montana State Univ., Bozeman (USA). Agricultural Experiment Station). Jul 1978. Contract EY-76-S-06-2228-003. 219p. Dep. NTIS, PC A10/MF A01.

An ecological investigation of reclamation and plant succession on strip mined land near Colstrip, Montana, was initiated in June, 1975. Its purpose was to examine and document development, stability, and permanence of plant communities established on semiarid mined land since 1928. Fenced exclosures on 1 to 8 year-old reclamation seedings and on 47 to 50 year-old naturally revegetated coal spoil were established. An exclosure was also established on adjacent native range. Transects set up within the exclosures for analyses of density, frequency, phenology, biomass production, and species composition were sampled throughout the growing season. Coordination with other research projects at Colstrip provided additional vegetation, soil, and weather data. Preliminary analyses indicated that some early successional stages associated with soil formation might be bypassed in reclamation by top-soiling, fertilizing, mulching, and seeding mixtures of plant species. Plant succession on seeded spoil was markedly influenced by variables, including species needed, weather conditions following seeding, initial seeding success, cultural practices, and post-mining management. Plant succession on naturally revegetated spoil was influenced by overburden characteristics, availability of seed sources, weather conditions following disturbance, and post-mining management. Preliminary conclusions are reported.

ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 6506, 6507, 6508

BASIC STUDIES

REFER ALSO TO CITATION(S) 6643, 6794

6614 (LA—7436-MS) **Water supply at Los Alamos during 1977.** Purtymun, W.D. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-31-109-ENG-38. 42p. Dep. NTIS, PC A03/MF A01.

The Los Alamos water supply for 1977 consisted of 1474 x 10^6 gal from wells in three fields and 57 x 10^6 gal from the gallery in Water Canyon. The production from the well fields was at its lowest volume since 1970. Water-level trends were as anticipated under current production practices. Well rehabilitation should be continued to ensure an adequate and reliable supply from wells that are 10 to over 25 yr old.

6615 (LA-UR—7468-PR) **Water quality in the vicinity of Fenton Hill Site, 1977.** Purtymun, W.D.; Stoker, A.K.; Adams, W.H.; Owens, J.W. (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

Water quality data have been collected from nine surface water stations, eleven ground water stations, and three ponds at the Fenton Hill Site, located in the Jemez Mountains, as part of a continuing program of environmental studies. There have been slight variations in chemical quality at individual stations during the year; however, these variations in water quality are within expected normal seasonal fluctuation and are not considered significant. In addition to the 14 routine chemical analyses performed twice annually, 17 trace metal analyses were run on one set of samples collected during the year.

6616 (Y/OWI/SUB—78/55412) **Workshop on dating old ground water.** (Arizona Univ., Tucson (USA)). 1978. Contract W-7405-ENG-26. 141p. Dep. NTIS, PC A07/MF A01.

A workshop on methods which might be used to date very old ground water was held on March 16—18, 1978, in Tucson, Arizona. The workshop was sponsored by the Office of Waste Isolation of Union Carbide Corporation as part of studies supported by the United States Department of Energy which are designed to evaluate the safety of proposed subsurface repositories for nuclear waste. The workshop was convened by the College of Earth Sciences of the University of Arizona with the cooperation of other university departments, particularly the Department of Physics. The dating of ground water in the vicinity of nuclear repositories is a critical aspect of the safety evaluation of these repositories. The age of the water gives an indication of past rates of water movement which in turn will help evaluate the likelihood of future migration of radionuclides from a given repository. Despite this rather obvious practical application, most of the workshop time was devoted to difficult technical questions related to the actual dating of the water.

6617 **Spatial distribution of phytoplankton species in chlorophyll maximum layers off southern California.** Reid, F.M.H.; Stewart, E.; Eppley, R.W.; Goodman, D. (Univ. of California, San Diego). *Limnol. Oceanogr., Suppl.;* **23**: No. 2, 219,226(Mar 1978).

The phytoplankton species assemblages of the chlorophyll maximum layer and the surface layer were compared in March 1976 at several stations off southern California. The assemblages in the two layers were quite different in the southern inshore part of the study area but were similar offshore and in Santa Monica Bay to the north. In both layers the assemblages changed more abruptly offshore than alongshore and gave the impression of elongate bands of phytoplankton oriented parallel to shore. Principal component analysis resolved two axes which accounted for the preponderance of the variability of species abundances. Component I consisted of several dinoflagellate and one coccolithophorid species, component II of several diatom species and the pigmented ciliate Mesodinium rubrum.

6618 **Annual subsurface transport of a red tide dinoflagellate to its bloom area: Water circulation patterns and organism distributions in the Chesapeake Bay.** Tyler, M.A.; Seliger, H.H. (The Johns Hopkins Univ., Baltimore). *Limnol. Oceanogr., Suppl.;* **23**: No. 2, 227, 245-246(Mar 1978).

An annual, long range, subsurface transport of Prorocentrum mariae-lebouriae, from the mouth of the Chesapeake Bay to its bloom area in the upper bay, a distance of 240 km, is described and completely documented. Prorocentrum in surface outflowing waters at the mouth of the bay is recruited in late winter into more dense inflowing coastal waters. Strong stratification produced by late winter—early spring surface runoff results in the development of a stable pycnocline. Prorocentrum, now in northward-flowing bottom waters, is retained in these bottom waters. It accumulates in a subsurface concentration maximum below the pycnocline and is transported northward to reach its bloom area in the Patapsco River and north of the Bay Bridge by late spring. The rapidly decreasing depth of the upper bay causes the pycnocline to rise, mixing the previously light-limited Prorocentrum and its nutrient-rich bottom waters to the surface, where rapid growth ensues. Once the dinoflagellate is in surface waters, positive phototaxis, combined with both wind- and tide-driven surface convergences, produce dense surface patches or red tides. Prorocentrum is effectively retained in the bay until late winter by sequential inoculation into the tributary estuaries on the western shore, which exchange relatively slowly with bay waters. By late winter the annual cycle is complete. Prorocentrum is again in surface waters at the mouth of the bay where it is reintroduced into northward-flowing bottom waters. The mechanisms described provide a key to understanding the origins of subsurface chlorophyll maxima and the delivery of toxic dinoflagellates to coastal bloom areas.

6619 **Detritus in the lake ecosystem.** Rich, P.H.; Wetzel, R.G. (Univ. of Connecticut, Storrs). *Am. Nat.;* **112**: No. 983, 57-71(1978).

Present views of the roles of detritus are not consistent with the ecosystem concept, and result in an underestimation of the importance of carbon and energy pathways involving detritus. Nonpredatory losses from a plant-herbivore transfer, particularly as dissolved organic matter and egestion, may be greater than the amount of material and energy transmitted up the grazer food chain. Ecosystem efficiencies are significantly higher than Lindeman (food chain) efficiencies. Benthic anaerobic metabolism (CO_2 production) is greater than benthic oxygen uptake estimates indicate, and the energy-rich intermediate products which undergo deferred respiration (O_2 uptake) far from their origin may create redox gradients, drive chemosynthesis, and subsidize bacterial photosynthesis in the water column. Thus, aquatic detrital material, particulate and dissolved, and its metabolism create a dynamic structure in lake sediments and water somewhat analogous to the trophic-dynamic aspect of the biota. However, detrital-dynamic structure in lakes is not simply an alternative mode of support for biota, but is a major factor in the entrainment of abiotic substances which subsidizes the biota.

6620 **Effectiveness of submersed angiosperm—epiphyte complexes on exchange of nutrients and organic carbon in littoral systems. II. Dissolved organic carbon.** Mickle, A.M.; Wetzel, R.G. (Michigan State Univ., Hickory Corners). *Aquat. Bot.;* **4**: No. 4, 317-329(1978).

Dissolved organic carbon concentrations, UV absorption, and fluorescence were measured daily for several weeks in water from an inlet stream of a hardwater lake before and after passing through three continuously, very slowly flowing (31/24 h) littoral systems. System I contained a natural stand of Scirpus subterminalis Torr. and Systems II and III contained Myriophyllum heterophyllum Michx. Macrophytic epiphytes were left intact. Dissolved organic matter of inflow and outflow water from System III was fractionated into several molecular weight fractions. Dissolved organic carbon concentrations and UV absorption increased as inflow water passed through all three littoral systems. This increase consisted only of organic compounds of >1000 molecular weight. Fluorescence increased in outflow waters of Systems I and III, but consistently decreased in System II. During periods of rainfall, but not snowfall, all three parameters in inflow water increased significantly. All three littoral systems were effective in dampening these higher concentrations; only slight increases appeared in the outflows.

6621 **Photosynthetic pathways of some aquatic plants.** Hough, R.A. (Wayne State Univ., Detroit); Wetzel, R.G. *Aquat. Bot.;* **3**: No. 4, 297-313(Dec 1977).

Over 40 species of aquatic angiosperms, including submersed, floating and emergent types, have been examined for photosynthetic status as part of a search for possible aquatic C_4 species. The C_4 system is viewed as potentially of adaptive value in certain aquatic situations, although evidence for its occurrence there is not conclusive. Emphasis was on plants from North-temperate softwater and hardwater lakes to explore both possibilities of CO_2 limitation, i.e., low total inorganic carbon in softwater vs. low free CO_2 in hardwater lakes. On the basis of leaf cross-section anatomy, all plants examined, with one exception, clearly did not show evidence of C_4 "Krantz anatomy." In the submersed plant Potamogeton praelongus Wulf, large starch-producing chloroplasts were concentrated in cells surrounding vascular bundles and in a narrow band of cells between vascular bundles. The in situ photosynthetic rate of this plant was twice that of a related species, but other evidence including PEP carboxylase content and photorespiratory response to high O_2 did not confirm the presence of the C_4 photosynthesis.

6622 **Further transition states of the Baja California upwelling ecosystem.** Walsh, J.J. (Brookhaven National Lab., Upton, N.Y.); Whitledge, T.E.; Kelley, J.C.; Huntsman, S.A.; Pillsbury, R.D. *Limnol. Oceanogr., Suppl.;* **22**: No. 2, 264-280(Mar 1977).

Measurements were made of wind, surface circulation, hydrography, nutrients, and phytoplankton and zooplankton rate processes in a time series at 27°N during April 1973. A string of current meters and a towed acoustic body were also used to assess the distribution of subsurface currents and red crabs. The seasonal onset

of upwelling had already occurred. Diatoms were initially the dominant primary producers. Two perturbations of the upwelling state were observed in response to relaxation of the winds. A comparison of this study with a preceding one in March 1972 indicates that the rate of upwelling, the nutrient content, and the phytoplankton specific growth rate were about the same in both years. The total productivity and biomass of the phytoplankton were less in 1973, implying that greater grazing stress was associated with a switch from smaller dinoflagellates to larger diatoms. Local temporal variability of upwelling off Baja California is postulated to have led to the replacement of clupeids by the red crab, Pleuroncodes planipes, as a facultative herbivore.

6623 Further transition states of the Baja California upwelling ecosystem. Walsh, J.J. (Brookhaven National Lab., Upton, NY); Whitledge, T.E.; Kelley, J.C.; Huntsman, S.A.; Pillsbury, R.D. *Limnol. Oceanogr.;* **22**: No. 2, 264-280(Mar 1977).

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6624 Significance of Nanoplankton in the Chesapeak Bay estuary and problems associated with the measurement of nonoplankton productivity. McCarthy, J.J.; Taylor, W.R.; Loftus, M.E. (Johns Hopkins Univ., Baltimore). *Mar. Biol.;* **24**: 7-16(1974).

Over a 2-year program of monthly cruises covering the entire Chesapeake Bay (USA), the phytoplankters which passed 35 μm mesh were responsible for 89.6% of the phytoplankton productivity. On a single summer cruise, the <35μm phytoplankton fraction was responsible for 93.4% of the chlorophyll a and 100% of the primary productivity. The <10 μm fraction was responsible for 81.3% of the chlorophyll a and 94% of the productivity. The difference in biomass in the <35 μm and the <10 μm fractions was significant ($P = 0.025$), but no significant difference in the productivity could be demonstrated. Laboratory experiments demonstrated that recently assimilated carbon can be lost with gravity screening. Considering both this and the effect of herbivorous zooplankters enclosed in productivity incubations, a prescreening rather than postscreening technique is recommended for studying nanoplankton productivity.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6326, 6543, 6559, 6640, 6749

6625 (COO—2308-006) **Avian radioecology on a nuclear power station site. Final report. Occurrence and effects of chronic, low-level oil contamination in a population of sooty terns (Sterna fuscata).** Robertson, M.J. (Manomet Bird Observatory, MA (USA)). 5 Jul 1978. Contract EY-76-S-02-2308. 48p. Dep. NTIS, PC A03/MF A01.

Records from 45,219 Sooty Terns (Sterna fuscata) captured for banding and examined for presence of oil on plumage were assessed for occurrence and effects of chronic, low-level oil contamination. Occurrence of oiled plumage averaged 2.6% for all years between 1962 and 1977, and ranged from 0.2% to 12.0% within years. Incidence of oiling increased significantly from the 1960's to the 1970's, and was far higher in 1970 than any other year. Oil was most frequently found on posterior, ventral plumage suggesting contact is made when Sooty Terns dip to the sea surface when foraging. A paired comparison shows that return rates were not significantly different between birds with and without detectable oil on plumage. Weights of oiled birds did not differ from controls, and no demonstrable effect of oiling on nesting was found. Sooty Terns are less susceptible to oil pollution than most other seabirds. Food is caught at or above the surface by contact dipping, and landing on the water is rare. (The report contains nothing about radioecology).

6626 (COO—4392-1) **Organic geochemistry of continental margin sediments. Research period: June 15, 1977—October 31, 1978.** Hung, J.M.; Whelan, J.K. (Woods Hole Oceanographic Institution, MA (USA)). 1978. Contract EG-77-S-02-4392. 11p. Dep. NTIS, PC A02/MF A01.

An instrument was purchased, set up, and is in operating condition to obtain detailed analyses of the hydrocarbons that have already been formed and those that potentially can be formed in continental margin sediment samples with depth in core holes along the continental margins of the United States.

6627 Future impact of fissil CO_2 on the sea. Fairhall, A.W.; Erickson, J.L. (Univ. of Washington, Seattle). *Nature (London);* **254**: No. 5497, 273-275(20 Mar 1975).

The Letters to the Editor section reported an objection and author rebuttal to several facets of a paper in which the chemical consequences of certain models used to predict the rate of fossil carbon dioxide accumulation in the oceanic mixed layer were presented.

6628 (ORNL/TM—6476) **Analysis of the chemical composition of streamflow components.** Huff, D.D.; Begovich, C.L.; Henderson, G.S. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 53p. Dep. NTIS, PC A04/MF A01.

Although it is known that some water quality constituents are more closely related to storm flows than dry weather flow, there have been few attempts to explicitly study the chemical composition of individual components of flow. A computer program based upon quick flow and delayed flow separation has been adapted to estimate concentrations and total amounts of various chemical constituents associated with these two components of flow. Preliminary indications are that many constituents are more strongly associated with either quick or delayed flow. Thus it may be possible to relate the effects of land use with chemical composition of quick flow or delayed flow more quantitatively than with the chemical composition of total stream flow.

6629 (RLO—2229-T1-45) **Transport and reaction of heavy metals in Alaskan fjord-estuaries. Annual report, April 1, 1977—May 31, 1978.** Burrell, D.C. (Alaska Univ., Fairbanks (USA). Inst. of Marine Science). May 1978. Contract EY-76-S-06-2229-001. 101p. Dep. NTIS, PC A06/MF A01.

Progress is reported on the following research projects; transport and reaction of heavy metals in Alaskan fjord-estuaries; suspended sediment dynamics; inorganic speciation of copper in estuarine environments; pollution of estuaries and confined coastal waters; deep-water current measurements in Resurrection Bay; and processes and fluxes controlling copper concentrations in an Alaskan fjord. Cruise reports are appended. (HLW)

6630 Purification of hydrocarbon-polluted water: preparation and study of the properties of materials. Espinosa, H. (Institut National des Sciences Appliquees, Toulouse, France); Goma, G.; Tribellini, A. *Water Res.;* **12**: No. 1, 11-20(1978). (In French).

A description is given of the production of a hydrophobic solid and its use in the treatment of water polluted with hydrocarbons. The hydrophobic solid consists of a support of either sand or brick on which fatty amines are grafted. This product has remarkable mechanical resistance as well as chemical and physical stability to temperature, pH, salinity, etc. We have studied the influence of the hydrocarbon feed rate, residence time, bed height and packing mesh size, on the exit hydrocarbon concentration. This material, which is a powerful interceptor of hydrocarbons, can be used in water treatment.

6631 Strategy for cleaning up our waters. Collins, R.L. pp 19-35 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

The United States is embarked on a national program to clean up its waters and eliminate pollutant discharge from all man-made sources. The purpose of this program is to protect not only human health and welfare from the direct impact of polluted water but also to protect the delicate web of life on which man's survival depends. The strategy for accomplishing this purpose is based on an attempt to blend a number of complex components including technological capability, economics, scientific measurement, and judgments about safety; all brought together by the political decision process. The strategy is being implemented through numerous daily decisions of government officials who are under pressure from industry, the general public, and special interest groups. The program is working—our waters are getting cleaner. However, as we put more effort into the program some of its weaknesses and oversights are becoming apparent. As we accomplish the easier goals potential road blocks to continued success will begin to appear.

6632 Tanker tragedies: identifying the source and determining the fate of petroleum in the marine environment. Brown, C.W.; Lynch, P.F. (Univ. of Rhode Island, Kingston). pp 135-148 of Environmental pollutants: detection and measurement. Toribara,

T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Three major oil spills this winter in the New England coastal area have forced immediate action on the part of oceanographic, chemical and biological researchers to determine the fate of the oil in the environment and its effects on aquatic life. This paper discusses the infrared and gas chromatographic analyses of air, water, sediment and tarball samples collected at one or more of these spill sites. The chemical partitioning of these petroleum samples in the environment is discussed and the possible source of "mystery" tarballs is conjectured based on infrared analyses.

6633 Water pollution studies using Raman spectroscopy. Van Haverbeke, L.; Brown, C.W. (Univ. of Rhode Island, Kingston). pp 149-169 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Methods for adapting laser Raman spectroscopy for monitoring water pollution have been developed and tested. Both conventional and resonance Raman spectra have been measured; the latter effect lowers the detection limits by approximately 10^3. In general, Raman spectroscopy has the following advantages in pollution studies: water is a very weak Raman scatterer, each chemical has a characteristic Raman fingerprint, quantitative measurements can be made easily, remote and flow-through detection systems are feasible. These advantages and the difficulties with the method are discussed herein.

6634 Controls and consequences of sulfate reduction rates in recent marine sediments. Goldhaber, M.B. (Yale Univ., New Haven); Kaplan, I.R. *Soil Sci.;* **119**: No. 1, 42-55(1975).

A brief review has been given of the process of bacterial sulfate reduction in respect to other processes in ocean sediments. In particular, rates of sulfate reduction have been discussed in the context of control mechanisms and geochemical consequences. It is concluded that besides temperature and pressure, which are cosmopolitan parameters influencing most biological processes, the rate of sulfate reduction is dependent on (1) total organic carbon preserved in sediment; (2) state of complexing of the organic matter and its availability for biogenic degradation. These two parameters are in turn influenced by (3) the environment of deposition and (4) the rate of sediment accumulation. Correlations are presented that show a direct relationship betwen rate of sulfate reduction and rate of sediment accumulation. The consequences of different rates of sulfate reduction on pyrite formation and isotope fractionation are discussed.

6635 Microdetermination of mercury and organomercury compounds in environmental materials. Uthe, J.F.; Armstrong, F.A.J. (Fisheries Research Board of Canada, Winnipeg, Manitoba). *Toxicol. Environ. Chem. Rev.;* **2**: No. 1, 45-77(1974).

Methods for determining mercury pollution are reviewed. Neutron activation analysis and colorimetric analysis both require expensive equipment and highly trained personnel. Atomic absorption analysis, however, requires less expense and skill and is therefore better adapted to large daily output of analyses. (JWP)

6636 Activation analysis and applications to environmental research. Filby, R.H.; Shah, K.R. (Washington State Univ., Pullman). *Toxicol. Environ. Chem. Rev.;* **2**: No. 1, 1-44(1974).

The principles of activation analysis as a method of trace element determination are discussed and applications of neutron activation analysis to environmental problems reviewed. Thermal and fast neutron activation analysis using nuclear reactors, accelerators and ^{252}Cf sources are considered and recent developments in γ-ray spectrometry such as Ge(Li) detectors, anticoincidence shielded Ge(Li) detectors and multidimensional NaI(Tl) spectrometers are outlined. The advantages and disadvantages and sources of error in neutron activation analysis for trace element determination are discussed with emphasis on problems associated with the analysis of environmental materials. Applications of neutron activation analysis to air pollution studies, marine and fresh-water trace element measuements and to the problem of mercury pollution are reviewed.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6577, 6578

WATER

REFER ALSO TO CITATION(S) 5335

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 6574, 6606

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 6818

REGULATIONS

REFER ALSO TO CITATION(S) 6631

6637 Financial responsbility for water pollution . *Fed. Regist. (Wash., D.C.);* **43**: No. 156, 35704-35718(11 Aug 1978).

From Shipping: Regulations affecting maritime carriers and related activities, 46bCFR542, Federal Maritime Commission. Financial responsibility for water pollution.

Part 542 of the Commission's rules has been revised to conform to the requirements of the 1977 Clean Water Act amendments to the Federal Water Pollution Control Act (33 U.S.C. 1321). Part 542 establishes procedures whereby vessel operators may demonstrate the financial ability to meet their liability to the United States for the costs of removing oil and other polluting substances discharged into any waters over which the United States has jurisdiction. Financial responsibility requirements are now $125 per gross ton or $125,000 (whichever is greater) for "inland oil barges;" $150 per gross ton for "vessels not carrying oil or hazardous substances as cargo;" and $150 per gross ton or $250,000 (whichever is greater) for "vessels which do carry oil or hazardous substances as cargo." Applications for Certificates of Financial Responsibility (Water Pollution) must be made to the Commission on Form FMC-321 and accompanied by applications and certification fees, as applicable. Certificates are issued for a term of 3 years. Unless a current Certificate is carried aboard a vessel, the vessel may be denied use of the navigable waters of the United States or of any port or place located thereon.

6638 Establishment of certain standards governing groundwater development. *Fed. Regist. (Wash., D.C.);* **43**: No. 150, 34127(3 Aug 1978).

From Conservation of Power and Water Resources, 18CFR803, Susquehanna River Basin Commission. Review of projects.

This rule amends the Commission's regulations governing review of projects by adding a new section establishing certain requirements of groundwater developers. The regulation requires groundwater developers to meter withdrawals, monitor water table levels, report water quality information, develop a water conservation program, and undertake a program to minimize losses from any distribution system. The present lack of knowledge about groundwater conditions and availability makes current and future users vulnerable to groundwater shortages and contamination.

6639 Effluent limitations guidelines for existing sources. *Fed. Regist. (Wash., D.C.);* **43**: No. 133, 29771-29781(11 Jul 1978).

From Protection of Environment, effluent guidelines and standards, 40nCFR440, Environmental Protection Agency. Ore mining and dressing point source category.

This rule promulgates effluent limitation guidelines for existing facilities engaged in the mining and milling of base and precious metals, and iron, aluminum, ferroalloy, uranium, radium, vanadium, and mercury and titanium ores. The final regulation amends an interim final regulation which was promulgated on November 6, 1975 (40 FR 51722), and represents the degree of control achievable by the application of the best practicable control technology currently available (BPT). These guidelines are issued under the Federal Water Pollution Control Act and are intended to restrict the discharge of pollutants into the Nation's waters.

6640 European aspects of environmental research and legislation. Geiss, F.; Bourdeau, P.; Carpentier, M. (Commission of the European Communities, Brussels). pp 37-51 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

The mechanisms of legislative activities in environmental matters for the European Communities are explained. Lists of accepted "directives" and some others under discussion illustrate these activities. An overview on both the direct and indirect action of the EC Environmental Research Programme is given. Three selected projects are described in some detail: the isotopic lead experiment (ILE), which aims at assessing the pathway of environmental lead through the environment to man; the EURASEP project, using the

NIMBUS G satellite-borne CZCS sensor for remotely measuring of coastal pollution; and the EC data bank on environmental chemicals (ECDIN).

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 5083, 5345, 6005, 6015

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 5271

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 5216, 5218

BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 6506, 6507, 6508, 6624, 6655, 6992

6641 (COO—3214-17) **Progress report on research on human genetics in Iceland.** (Iceland Univ., Reykjavik). 31 Oct 1978. Contract EY-76-C-02-3214. 108p. Dep. NTIS, PC A06/MF A01.

Portions of document are illegible.

In 1977 the work has continued as outlined in previous proposals. The general demographic register, which covers the Icelandic population from the year 1840 to present, was still improved. The register contains some 313,000 birth records, and they are kept either on magnetic discs, punched cards, or on written forms. The register was used to investigate the possible inheritance of disabilities and diseases as well as other characters and the effect of environment on man.

6642 **Automated system for fractionation of blood samples.** Lee, N.E.; Genung, R.K.; Johnson, W.F.; Mrochek, J.E.; Scott, C.D. (Oak Ridge National Lab., TN). *Clin. Chem.;* **24**: No. 8, 1361-1365(Aug 1978).

We describe a prototype system for preparing multiple fractions of blood components (plasma, washed erythrocytes, and hemolysates) by use of automated techniques. The procedure is based on centrifugal separation and sample transfer by induced pressure differentials in a blood-processing vessel (rotor) that has been designed to process 24 samples simultaneously. Erythrocytes are sedimented against the outer walls of individual sample chambers, and plasma is siphoned, by imposition of either a slight positive or negative pressure, into individual reservoirs in a collection ring. Cells are washed in situ; samples of washed cells, either packed or in saline solution, can be recovered. Cellular hemolysates are automatically prepared and transferred to individual, commercially available collection vials, ready for immediate analysis or for storage in liquid nitrogen. The system has potential application in any biomedical area in which many samples are to be expeditiously analyzed and in which one or more of the blood fractions will be used. A separate unit has been designed and developed for the semiautomated cleaning of the rotor.

6643 **Presence of the red-spotted newt, Notophthalmus viridescens rafinesque (amphibia, urodela, salamandridae), in waters exceeding 12 meters in Lake George, New York.** George, C.J. (Union Coll., Schenectady, NY); Boylen, C.W.; Sheldon, R.B. *J. Herpetol.;* **11**: No. 1, 87-90(1977).

The newt was commonly encountered in depths ranging from the highly organic shallows of embayments to depths up to 13 meters. The incidence of the species in depths greater than a few meters is generally unrecognized. Several possible reasons for the deep habitat of these newts may be inferred. In most instances the newts were found at or just below the thermocline. Throughout the summer, as the thermocline shifted to deeper depths, so did the newts, possibly indicating a thermal preference. Such behavioral thermoregulation has been demonstrated in the red-bellied newt in which the aquatic adults avoided temperatures above 18 to 20°C but showed little avoidance of near-freezing temperatures. The cover and food associated with the vast beds of NITELLA FLEXILIS may be other factors.

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 6643

6644 (ORO—4023-9) **Drosophila dispersal and species packing. Progress report, 1977—1978.** (Texas Univ., Austin (USA)). 18 Jul 1978. Contract EY-76-S-05-4023. 12p. Dep. NTIS, PC A02/MF A01.

Research on Drosophila phyletic species packing and dispersal has moved into slightly more advanced areas of theoretical development relating community evolution and stability characteristics. Plans are being made for obtaining comparative data on other organisms which have exhibited drastic modifications in their geographic range. The recent developments in the theoretical significance of dispersal affecting genetic divergence among neighboring populations is also being related to geographic divergence, and possibly speciation, as a result of progress in the past year.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 4944, 6676, 6677, 6682, 6683, 6685, 6688, 6689, 6690, 6691, 6693, 6716, 6717, 6721, 6722, 6750, 6753, 6756, 6760, 6798

6645 (BNL—24704) **Identification of zein structural genes in the maize genome.** Burr, B. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 8p. (CONF-780955—2; IAEA-SM—230/72). Dep. NTIS, PC A02/MF A01.

From Symposium on seed protein improvement in cereals and grain legumes; Neuherberg, F.R. Germany (4 Sep 1978).

Zein is the major storage protein in maize endosperm and is deficient in the amino acids lysine and tryptophan, the amino acids generally limiting in cereal grains. If the two subunits of zein were each encoded by a single gene, it is possible to envisage a program in which altered gene products containing these two amino acids could be selected. Since zein constitutes such a large proportion of the total protein, substitutions of rare amino acids into zein will be reflected in the overall amino acid composition of the kernel. At the moment we do not know how many genes for zein there are, nor do we know where they are located in the genome. In our approach to this question we have purified the messenger RNAs for the two zein polypeptide chains free from all other species of RNA. The mRNAs are polyadenylated, have a cap structure at their 5' terminus, and contain slightly less than 50% noncoding sequences. Their average length is 1.1 kilobases and we assume they are monocistronic. Using reverse transcriptase and DNA polymerase we prepared double-stranded DNA transcripts of the messages. These were inserted into the bacterial plasmid pMB9 and used to transfect E. coli. A number of clones carrying nearly full length inserts have been selected for study. These recombinant DNA molecules are being used as probes to accurately count the number of zein genes in the maize genome, check for amplification, and determine the chromosomal location of the genes.

6646 (BNL—24705) **Zein synthesis and processing on zein protein body membranes.** Burr, F.A. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 12p. (CONF-780955—1; IAEA-SM—230/71). Dep. NTIS, PC A02/MF A01.

From Symposium on seed protein improvement in cereals and grain legumes; Neuherberg, F.R. Germany (4 Sep 1978).

The storage protein of maize, zein, is translated from messenger RNA on ribosomes bound to the outer membrane of the zein protein bodies. No other proteins appear to be made on this membrane. Before zein is transported through the protein body membrane it undergoes at least two post-translational modifications, which are discussed.

6647 (COO—3286-20) **Study of the radiation effects on nucleic acids and related compounds. Annual progress report, November 15, 1977—November 14, 1978.** Wang, S.Y. (Johns Hopkins Univ., Baltimore, MD (USA)). Jul 1978. Contract EY-76-S-02-3286. 9p. Dep. NTIS, PC A02/MF A01.

Acquisition of information on molecular biology involves four stages: establishment of procedures for the separation, isolation, and characterization of radiation products of nucleic acid bases, nucleosides, etc.; development of methods for the synthesis of these products once they are identified so that a constant supply in milligram to gram quantities is available for the studies in stages 3 and 4; examination of the apparent biological effects of each product in vitro and in vivo; and study of the molecular mechanism related to an observed biological phenomenon. In view of the difficulties experienced in this area of research and this deliberate and careful investigative approach, it was generally believed that progress toward our final goal would be rather prolonged. Yet the elucidation

of a molecular mechanism by which ionizing radiation induces mutation in vivo is very near at hand. Further progress has been made in the separation and isolation of three hydroperoxy derivatives of thymidine. One communication has appeared and another has been submitted for publication. The former reports the efficient stereospecific synthesis of cis-pyrimidine glycols and the latter describes the study of mutagenicity and toxicity of seven radiation products of thymine and thymidine using Ames Salmonella test. Also, a quantitative study of the reversion of cytosine N(3)-oxide, a hydroperoxidation product induced by 6-TOOH, to cytosine has been carried out.

6648 (COO—3286-21) Molecular bases for radiation mutagenesis. Three year progress report, November 15, 1975—November 14, 1978. Wang, S.Y. (Johns Hopkins Univ., Baltimore, MD (USA)). Jul 1978. Contract EY-76-S-02-3286. 29p. Dep. NTIS, PC A03/MF A01.

Studies on isolation and characterization of radiation products included: isolation and identification of cis- and trans-Thy glycols from the mixture of gamma irradiation products of Thy; identification of two isomers as radiation products from radiolysis of cytosine in aerated aqueous solutions and radiolysis of Thd in aerated aqueous solutions. Studies on synthesis of radiation products included: Stereospecific synthesis of cis- and trans-pyrimidine glycols; preparation of pyrimidine hydroperoxide; and synthesis of cis- and trans-1-carbamylimidazolidone-4, 5-diols. Studies on biological effects were conducted using human lymphocyte cultures, Chinese hamster cells, and root tip cells of Vicia faba. Effects of 6-TOOH on chromosomal aberrations, colony-forming ability, and unscheduled DNA synthesis were studied. Mutagenic effects of radiation products of Thy derivatives were investigated. Methods and procedures are described for UV-spectroscopic study, isolation of products, characterization of products, kinetic studies, mechanistic studies, and tracer studies. (HLW)

6649 Extraction of erythropoietin from normal kidneys. Sherwood, J.B.; Goldwasser, E. (Univ. of Chicago). *Endocrinology;* **103**: No. 3, 866-870(Sep 1978).

Significant amounts of active erythropoietin were extracted from the kidneys of normal rats, cattle, dogs, and rabbits by homogenization of the organs in 0.1 M phosphate buffer. The mean erythropoietin activities of the extracts, as determined by the starved-rat assay, were 0.26 U/g beef kidney, 0.41 U/g dog kidney, and 0.11 U/g rat kidney. The dog kidney extracts had a mean activity of 0.35 U/g, as measured by stimulation of hemoglobin synthesis in cultured bone marrow cells (in vitro assay) and produced a dose-dependent stimulation of ^{59}Fe incorporation into circulating red cells when assayed in polycythemic mice. Extracts of rabbit kidney cortices had a mean activity of 2.12 U/g, as measured by stimulation of hemoglobin synthesis in cultured bone marrow cells. When the dog kidney homogenate was fractionated on DEAE-cellulose, all of the erythropoietin activity was adsorbed to the exchanger in the presence of 0.01 M acetate buffer, pH 4.5, and was completely eluted by 0.1 M Na_2HPO_4-0.5 M NaCl, pH 8. An antibody made aganist human urinary erythropoietin completely inactivated the erythropoietic factor in the dog kidney extract. Serum from a donor dog had no erythropoietin activity when assayed in the starved rat, suggesting that the factor in the extracts is intracellular erythropoietin rather than that contained in plasma trapped in the renal vasculature. The complete inactivation of the erythropoietic factor in these kidney homogenates by antierythropoietin and its behavior on DEAE-cellulose indicate that this factor is structurally similar to native plasma erythropoietin. The extracts are completely active without being incubated in the presence of serum.

6650 Comparison of specific binding sites for Escherichia coli RNA polymerase with naturally occurring hairpin regions in single-stranded DNA of coliphage M13. Niyogi, S.K.; Mitra, S. (Oak Ridge National Lab., TN). *J. Biol. Chem.;* **253**: No. 16, 5562-5567(25 Aug 1978).

Escherichia coli RNA polymerase binds specifically to the single-stranded circular DNA of coliphage M13 in the presence of a saturating concentration of the bacterial DNA binding protein presumably as an essential step in the synthesis of the RNA primer required for synthesizing the complementary DNA strand in parental replicative-form DNA. The RNA polymerase-protected DNA regions were isolated after extensive digestion with pancreatic DNase, S1 endonuclease of Aspergillus oryzae, and exonuclease I of E. coli. The physicochemical properties of the RNA polymerase-protected segments (called PI and PII) were compared with those of the naturally occurring hairpin regions.

6651 Fv-1 locus restriction of mouse retroviruses in glucocorticoid-treated cells. Tennant, R.W.; Jones, S.C.; Otten, J.A.; Yang, W.K.; Brown, A. (Oak Ridge National Lab., TN). *Virology;* **89**: No. 1, 335-341(Aug 1978).

Treatment of mouse embryo cells with hydrocortisone (10^{-6}M) or dexamethasone (10^{-6} to 10^{-8}M) increases virus synthesis whether the cells are permissive or restrictive at the Fv-1 locus. However, the number of cells infected was not increased in either permissive or restrictive cells by treatment with either glucocorticoid, and the two-hit titration pattern in restrictive cells remained unaltered. Therefore, the enhancement of virus replication by the glucocorticoids is independent of Fv-1 restriction and appears to occur after the Fv-1 locus-sensitive step in virus synthesis.

6652 Separation and analysis of arylsulfatase isoenzymes in body fluids of man. Bostick, W.D. (Oak Ridge National Lab., TN); Dinsmore, S.R.; Mrochek, J.E.; Waalkes, T.P. *Clin. Chem.;* **24**: No. 8, 1305-1316(Aug 1978).

Soluble arylsulfatase (EC 3.1.6.1) is present in the body fluids of man in the form of two isoenzymes, arylsulfatase A and B, which reportedly are useful biochemical markers for certain types of malignancy. However, rapid assay of the individual isoenzymes is extremely difficult; procedures based on differential inhibition or activation of the isoenzymes in a mixture yield only semiquantitative results. A feature of these isoenzymes is their inhibition by some common anions (notably phosphate) at physiologic concentrations. The isoenzymes can be separated by anion-exchange chromatography, the B isoenzyme being eluted in the void volume and the A isoenzyme and the anionic inhibitors retarded. Lead is used to sequester phosphate, enabling measurement of A in the salt-eluded fraction. Using this technique, we have found significant elevations of B in the sera of patients with colorectal cancer. The potential of rapid, chromatographic separation coupled with continuous monitoring for arylsulfatase activity is discussed.

6653 Chromatographic separation and continuously referenced, on-line monitoring of creatine kinase isoenzymes by use of an immobilized-enzyme microreactor. Denton, M.S.; Bostick, W.D.; Dinsmore, S.R.; Mrochek, J.E. (Oak Ridge National Lab., TN). *Clin. Chem.;* **24**: No. 8, 1408-1413(Aug 1978).

We describe a new concept in continuously referenced monitoring of the isoenzyme activities of creatine kinase (EC 2.7.3.2) after liquid-chromatographic separation. After separation on a diethylaminoethyl-Sephacel column, the three isoenzymes of creatine kinase undergo a series of coupled enzyme reactions, ultimately resulting in the formation of ultraviolet-detectable NADPH. A major advantage of this detection system is the immobilized-enzyme microreactor (2 x 17 mm), which may be removed and stored refrigerated when not in use. A split-stream configuration allows self-blanking of endogenous ultraviolet-absorbing constituents in authentic sera samples, which would otherwise make definitive diagnosis and quantitation difficult or impossible. This detection system is applicable to the automated analysis of creatine kinase isoenzymes in the clinical laboratory.

6654 Effect of the reciprocal relationship of Ca^{2+} and cAMP on the control of beating in cultured rat heart cells. Harary, I.; Wallace, G.A. (Univ. of California, Los Angeles). *Recent Adv. Stud. Card. Struct. Metab.;* **12**: 635-643(1978).

The demonstration of Ca^{2+} control of the cAMP level in heart cells and the localization of the Ca^{2+} activator protein of cAMP phosphodiesterase on the sarcoplasmic reticulum (SR) have led us to postulate a model whereby the Ca^{2+} flux is related to the cAMP flux. The model suggests that the increase in cytosol Ca^{2+} automatically results in an increase in SR Ca^{2+} and a subsequent decrease in cAMP to allow for the periodic flux of Ca^{2+} and cAMP in the contraction cycle.

6655 Divergence of metabolic activation systems for short-term mutagenesis assays. Selkirk, J.K. (Oak Ridge National Lab., TN). *Nature (London);* **270**: No. 5638, 604-607(15 Dec 1977).

Polycyclic hydrocarbons such as benzo(a)pyrene are prevalent environmental contaminants and are increasingly suspect as human carcinogens. The metabolite profiles for benzo(a)pyrene in numerous species and tissues such as skin has not produced unique metabolites that are not present in resistant tissues. Quinones are formed both enzymatically and non-enzymatically, and their role in tumorigenesis remains uncertain. Therefore, susceptibility to tumorigenesis by these chemicals may be a function of metabolite kinetics since the rate of formation and removal of the activated carcinogenic species of benzo(a)pyrene may greatly influence the probability of the active molecules alkylating target site for carcinogenesis. If the diol-epoxide intermediate is one of the necessary requisites for development of the malignantly transformed state, then it will be critically important to compare metabolite patterns in susceptible and resistant tissues, species and cells. Benzo(a)pyrene metabolism by liver microsomes, both rat and hampster, were compared against metabolism by hampster embryo cells and hampster embryo cell microsomes with the use of high-pressure liquid chromatography.

6656 Secondary structure of histones and DNA in chromatin. Thomas, G.J. Jr. (Southeastern Massachusetts Univ., North Dartmouth); Prescott, B.; Olins, D.E. *Science;* **197**: 385-388(22 Jul 1977).

Laser Raman spectroscopy indicates that the inner histones which are bound to DNA in chromatin or in isolated nu bodies are

similar in conformation to the inner histones which are dissociated from DNA in high-salt solutions. This structure contains, on the average, 51 +- 5% α-helix and no substantial β-sheet conformation. It is proposed that the protein core of the nu body has a high α-helix content.

6657 CHO cell mutants for arginyl-, asparagyl-, glutaminyl-, histidyl-, and methionyl-transfer RNA synthetases: identification and initial characterization. Thompson, L.H.; Lofgren, D.J.; Adair, G.M. (Univ. of California, Livermore). *Cell;* **11**: 157-168(May 1977).

A number of conditional lethal mutants of CHO cells that are defective in protein synthesis have been characterized with respect to their biochemical lesions. A defective aminoacyl-tRNA synthetase appears to be the basis of each mutant phenotype. In each strain, the specific activity in vitro of the synthetase cognate for one of the following amino acids was substantially reduced: arginine, asparagine, glutamine, histidine or methionine. One mutant, Arg-1, gave no detectable arginyl-tRNA synthetase activity, suggesting that it contains an altered enzyme that is unstable in vitro. Most of the mutants correspondingly exhibited impaired aminoacylation in vivo under nonpermissive conditions. However, two mutants, Arg-1 and His-1, appeared to have normal levels of acylated tRNA under the nonpermissive conditions which inhibited protein synthesis to approximately 50% and 10%, respectively. The expression of each mutant's phenotype, measured by rates of protein synthesis or growth, was a function of temperature and/or the concentration of amino acid cognate for the synthetase found to be deficient in vitro. The properties of these mutants make them applicable to diverse problems related to translation in mammalian cells.

6658 Carcinogen ethionine elevates progesterone levels. Sharma, O.K.; Borek, E. (Univ. of Colorado Medical Center, Denver). *Nature (London);* **265**: No. 5596, 748-749(24 Feb 1977).

ETHIONINE is a potent carcinogen, but little is known about its mode of action. It is known that it does not react extensively with DNA. It may be an ubiquitous carcinogen, as it is synthesized by Escherichia coli and several other microorganisms, so studies of its mode of action are important. It was reported recently a novel effect of ethionine in the immature chick. The oviducts of chicks previously stimulated with oestrogen behaved after the administration of ethionine as if they had received a second stimulation with oestrogen or progestin. The egg white proteins, ovalbumin and conalbumin were synthesized and distinct morphological changes, characteristic of stimulation by oestrogen or progestin appeared. It was thus not clear whether ethionine (or its metabolic product) was affecting steroid hormone receptors directly, or interfering in some way with steroid hormone metabolism to produce elevated levels of endogenous oestrogen or progestin. It was found that ethionine or its sulphoxide are unique in inducing in the chick oviduct the effects cited above; analogues were inactive, also the administration of ethionine elevates serum progesterone levels over 10-fold, to a concentration which may be sufficient to account for the profound changes in the immature oviduct.

6659 Active calcium transport via coupling between the enzymatic and the ionophoric sites of Ca^{2+} + Mg^{2+}-ATPase. Shamoo, A.E.; Scott, T.L.; Ryan, T.E. (Univ. of Rochester, NY). *J. Supramol. Struct.;* **6**: 345-353(1977).

The 20K dalton fragment of Ca^{2+} + Mg^{2+}-ATPase obtained from the tryptically digested sarcoplasmic reticulum has been further purified using Bio-Gel P-100. This removed low-molecular-weight UV-absorbing and positive Lowry-reacting contaminants. The ionophoric activity of the 20K fragment in both oxidized cholesterol and phosphatidylcholine:cholesterol membranes is unaltered by this further purification. The 20K selectivity sequence in phosphatidylcholine:cholesterol membranes is $Ba^{2+} > Ca^{2+} > Sr^{2+} > Mn^{2+} > Mg^{2+}$. Digestion of intact sarcoplasmic reticulum vesicles with trypsin, which results in the dissection of the hydrolytic site (30K) from the ionophoric site (20K), is shown to disrupt energy transduction between ATP hydrolysis and calcium transport. This further implicates the 20K dalton fragment as a calcium transport site. These data and previous evidence are discussed in terms of a proposed model for the ATPase molecular structure and the mechanism of cation transport in sarcoplasmic reticulum.

6660 Serum chemistry values of normal dogs (beagles): associations with age, sex, and family line. Kaspar, L.V.; Norris, W.P. (Argonne National Lab., IL). *Lab. Anim. Sci.;* **27**: No. 6, 980-985(1977).

One hundred and sixteen colony control dogs (purebred beagles), ranging in age from 56 to 4868 days at the time of sampling, were tested at various intervals over a 10-year period to determine the normal values of several serum constituents. The effects of sex and family line were also noted. With increasing age, serum glutamic-pyruvic transaminase, total protein, and cholesterol increased, whereas glucose, serum glutamic-oxalacetic transaminase, creatine phosphokinase, iron, alkaline phosphatase, and albumin decreased. Females had significantly higher levels of urea nitrogen, iron, and cholesterol than males. Males had significantly higher serum glutamic-pyruvic transaminase levels. The rate of increase in serum cholesterol with age was greater in males than in females. Males showed no age related changes in levels of urea nitrogen or iron, while the females showed decreasing levels. Significant differences in total protein and albumin were noted in dogs belonging to different family lines.

6661 Conformational properties of nucleic acids in solution. Sarma, R.H. (State Univ. of New York, Albany); Danyluk, S.S. *Int. J. Quant. Chem., Symp.;* **4**: 269-276(1977).

Principles which govern the conformational properties of nucleic acid structures in aqueous solution are derived from extensive nuclear magnetic resonance studies of nucleic acid components. These principles are then utilized to project the solution conformation of tRNA.

6662 Bile salt kinetics in cystic fibrosis: influence of pancreatic enzyme replacement. Watkins, J.B.; Tercyak, A.M.; Szczepanik, P.; Klein, P.D. (Children's Hospital Medical Center, Boston). *Gastroenterology;* **73**: No. 5, 1023-1028(1977).

Bile acid kinetics was investigated by stable isotope dilution technique in 6 children (ages $3\frac{1}{2}$ months to $4\frac{1}{2}$ years) with previously untreated cystic fibrosis. All of the patients had clinical and laboratory evidence of malabsorption, normal intestinal mucosal function, as judged by glucose absorption, intestinal histology, disaccharidase levels, and normally functioning gallbladders. The children were maintained on a constant diet throughout the study period; fat intake averaged 4.2 g per kg per day. Before administration of pancreatic enzyme replacement, fat excretion equalled 50 +- 4% (mean +- SE) of intake and was reduced to 20 +- 1.0% of intake after therapy. Total bile acid pool size nearly doubled during enzyme replacement from 379 +- 32 μmoles per kg to 620 +- 36 μmoles per kg with secondary bile acids comprising 57% of the total pool before therapy and 40% after therapy. The data indicate that both primary and secondary bile acids are conserved within the enterohepatic circulation during enzyme therapy, and that the mechanism for the regulation of hepatic bile acid synthesis is intact in cystic fibrosis. However, the demonstration that large amounts of bile acid continue to be excreted during therapy suggests that interruption of the enterohepatic circulation continues and that deficiencies of the intraluminal phase may persist during enzyme therapy in this disease.

6663 Effects of ionophores on the fluorescence of the cation 3,3'-dipropyloxadicarbocyanine in the presence of pigeon erythrocytes, erythrocyte ghosts or liposomes. Kimmich, G.A.; Philo, R.D.; Eddy, A.A. (Univ. of Manchester Inst. of Science and Tech., Eng.). *Biochem. J.;* **168**: 81-90(1977).

Pigeon erythrocytes, resealed lysed erythrocytes or liposomes derived from erythrocyte lipids were suspended in solutions containing up to 2 μM-3,3'-dipropyloxadicarbocyanine iodide. Gramicidin, valinomycin, nigericin or carbonyl cyanide p-trifluoromethoxyphenylhydrazone, or combinations of these, were used to induce electrical diffusion potentials dependent on Na^+, K^+ or protons. In each instance hyperpolarization of the cell membrane lowered the fluorescence of the cell suspension, a process that was completed in about 1 min. Subsequent depolarization caused an increase in fluorescence. Quenching of the fluorescence of the cell suspension appeared to be due to the reversible binding of the dye to the cells. Much larger amounts of dye were bound, both to the intact and to the resealed erythrocytes, than would be expected if partitioning of the dye cation followed the Nernst equation. The dependence of the binding on the extracellular dye concentration was studied in the presence and absence of valinomycin. The results were consistent with the suggestion of Sims, Waggoner, Wang and Hoffman that the dye was bound at both membrance surfaces and that, at low dye concentrations, hyperpolarizing the cells promoted dye binding at the inner membrane surface. The applications of the technique are limited by the circumstance that the direct effect of the electric field on the uptake of the dye into the cells is amplified by a binding process that may be affected by other physiological variables.

6664 Effects of indoleacetic acid on the quantity of mitochondria, microbodies, and plastids in the apical and expanding cells of dark-grown oat coleoptiles. Shen-Miller, J.; Gawlik, S.R. (Argonne National Lab., IL). *Plant Physiol.;* **60**: 323-328(1977).

We determined the number of mitochondria, microbodies, and plastids in dark-grown oat (Avena sativa) coleoptiles following incubation in indoleacetic acid (IAA) for a period of 60 minutes at 6-minute intervals. In the apical outer epidermis of coleoptiles, the mitochondria increased from 31.4 to 35 per cell section with a 6-minute incubation in IAA, and this trend persisted over the 60-minute incubation. Neither the microbodies, plastids, nor the dictyosomes (Gawlik and Miller 1974 Plant Physiol. 54: 217-221) responded to the hormone. The apical parenchyma showed no change in quantity of any of the organelles including the dictyosomes during IAA incubation. The quick response of mitochondria in the coleop-

tile tip could be interpreted as an association of this organelle with hormone transport, growth, or perhaps with gravity perception. In the subapical expansion reion, IAA caused significant reductions of mitochondria, microbodies, and dictyosomes in the outer epidermis compared to the control, the timing of which preceded the IAA-induced elongation and of geotropism. The fast response of organelles in the various cells is probably a change in organelle volume rather than number. That microbodies show a response to the plant hormone in the permanently achlorophyllous epidermis indicates that these organelles, in addition to their peroxisomal functions in green leaves, also may have a growth regulation function. IAA treatment was without effect on the quantity of the various types of plastids (including the amyloplasts) in the different oat coleoptile cells.

6665 2,4-dinitrophenol causes a marked increase in the apparent K/sub m/ of P/sub i/ and of ADP for oxidative phosphorylation. Kayalar, C.; Rosing, J.; Boyer, P.D. (Univ. of California, Los Angeles). *Biochem. Biophys. Res. Commun.;* **72**: No. 3, 1153-1159(1976).

During oxidative phosphorylation by beef-heart submitochondrial particles, the presence of an uncoupler, 2,4-dinitrophenol, causes over a ten-fold increase in the apparent Michaelis constants of P/sub i/ and of ADP. These results are consistent with an energy-linked conformational change that promotes the binding of P/sub i/ and ADP in a mode competent for ATP synthesis.

6666 Interference with the serum gastrin response to feeding after surgical intervention with the rat thyroparathyroid complex. Cooper, C.W.; Doppelt, S.H.; Talmage, R.V. (Univ. of North Carolina, Chapel Hill). *Proc. Soc. Exp. Biol. Med.;* **153**: 16-21(1976).

Gastrin is a potent thyrocalcitonin secretagogue in a number of mammalian species, including man. Conversely, in man and other mammals some work has suggested that increased blood levels of thyrocalcitonin, in turn, can act to suppress a number of gastrointestinal functions, including secretion of gastrin. Rats adapted for 2-3 weeks to a fixed schedule of daily feeding exhibited high serum gastrin levels and large increases in serum gastrin after feeding. Serum gastrin was >500 pg/ml throughout most of the 24 hr daily cycle and fell to approximately 150 pg/ml 1 hr before the scheduled time of feeding; by 1-2 hr after feeding serum gastrin rose again to >500 pg/ml. This postprandial increase in gastrin was not observed if food was withheld and it was seen also after truncal vagotomy which itself raised serum gastrin. In contrast, in nonadapted rats serum gastrin was unmeasurable (<20 pg/ml) after a 24 hr fast and rose only to approximately 100 pg/ml 1-2 hr after feeding. In nonadapted rats, thyroidectomy prevented the 2 hr rise in serum gastrin after feeding. In adapted rats parathyroidectomy, thyroparathyroidectomy, and thyroidectomy with parathyroid autotransplantation, all reduced serum gastrin before and after feeding indicating that any surgical intervention with the thyroparathyroid complex interfered with gastrin release. Rats with autotransplanted parathyroid glands and intact thyroid glands showed a delayed increase in serum gastrin after feeding, as well as a delay in the usual fall in plasma phosphate, ^{45}Ca, and ^{32}P, but if the parathyroids were replaced within the thyroid tissue, this delay did not occur.

6667 Calcitonin and the bone fluid compartment. Effect of calcitonin and/or parathyroid hormone on plasma radiocalcium changes. Doppelt, S.H.; Talmage, R.V. (Univ. of North Carolina School of Medicine, Chapel Hill). *Clin. Orthop.;* No. 118, 242-249(1976).

Changes in plasma calcium and ^{45}Ca concentrations were followed after injection of calcitonin or a combination of calcitonin (CT) and parathyroid hormone (PTH) into thyroparathyroidectomized rats maintained on thyroxine. Comparison was made between rats injected with the hormone(s) after a recent feeding and after an overnight fast. Also compared were plasma ^{45}Ca changes when the radionuclide was injected 18 hr (18 hr ^{45}Ca) before, and more than 6 days (> 6 day ^{45}Ca) prior to hormone administration. The following results were obtained: The action of CT predominated over that of PTH for the first few hours after injection. However, the effects of PTH were eventually manifested even when additional CT was administered. In the "> 6 day" ^{45}Ca groups. PTH normally produced an increase in plasma ^{45}Ca specific activity. However, in fasted rats, plasma ^{45}Ca fell with total calcium with no change in specific activity following CT injection. In fed rats CT injection was followed by a decrease in plasma ^{45}Ca specific activity. When both hormones were administered plasma ^{45}Ca specific activity changes mimicked those produced by CT alone even after PTH plasma effects were manifested. In the "18 hr" ^{45}Ca groups, CT produced first a drop in plasma ^{45}Ca, followed by a reduction in the rate of its removal from plasma. It is concluded that the data can best be explained by the postulate that plasma calcium concentrations are maintained by the control of fluxes between bone fluid in the osteocyte-lining cell bone unit and the extracellular fluid. PTH increases the efflux from this bone fluid compartment while CT restricts the source of calcium and, therefore, the efflux. Plasma ^{45}Ca changes are due to a combination of changes in flux rates and mixing processes between the extracellular fluid compartment and the bone fluid compartment.

6668 Synthesis and biological activity of some novel analogs of thymidine. Cheng, Y.C.; Neenan, J.P.; Goz, B.; Ward, D.C.; Prusoff, W.H. (Yale Univ. School of Medicine, New Haven). *Ann. N.Y. Acad. Sci.;* **255**: 332-341(8 Aug 1975).

Two new types of compounds have been developed that offer great promise for clinical utility. 5'-amino-2', 5'-dideoxy-5-iodouridine (AIU) and N-(5'-adenosyl). N'-(5'-thymidyl)-azelaamide (ATA) have been found to have effective antiviral and antineoplastic activity, respectively. The insertion of an amino group in the 5'-position of pyrimidine deoxyribonucleosides halogenated in the 5-position of the pyrimidine moiety has created soluble antiviral agents that have a high therapeutic index, presumably because they cannot be phosphorylated with subsequent incorporation into DNA. This minimizes potential carcinogenic or mutagenic effects of those halogenated nucleosides that are so incorporated into DNA.

6669 Carbamylcholine and acetylcholine-sensitive, cation-selective ionophore as part of the purified acetylcholine receptor. Shamoo, A.E.; Eldefrawi, M.E. (Univ. of Rochester, NY). *J. Membr. Biol.;* **25**: 47-63(1975).

Black lipid membranes were formed with oxidized cholesterol in the presence of either the acetylcholine receptor, purified from the electric organ of the electric ray Torpedo californica or its tryptic digest. In both cases, conductance of cations increased and was dependent on the concentration of the receptor protein. Conductance of Ca^{++} was dependent on its concentration, but addition of carbamylcholine gave no reproducible or consistent effects. Only in the case of the tryptic digest of the acetylcholine receptor did carbamylcholine and acetylcholine consistently induce monovalent cation selective conductance (P/sub Na,K/: P/sub Cl/ = 4.4). The induced monovalent cationic conductance due to carbamylcholine (10 μM) varied from 10- to over 100-fold. Curare (10 μM) prevented the action of carbamylcholine. Na-dodecyl sulfate gel electrophoresis of the acetylcholine receptor, before and after tryptic digestion, indicated that this mild enzyme treatment hydrolyzed the receptor molecule subunits. Nevertheless, the receptor molecule retained its full binding of [acetyl-^{3}H]acetylcholine; and analytical gel electrophoresis indicated that it remained intact possibly through hydrogen, hydrophobic and disulfide bonding.

6670 ^{31}P nuclear magnetic resonance studies on serum low and high density lipoproteins: effect of paramagnetic ion. Henderson, T.O.; Kruski, A.W.; Davis, L.G.; Glonek, T.; Scanu, A.M. (Univ. of Illinois at the Medical Center, Chicago). *Biochemistry;* **14**: No. 9, 1915-1920(1975).

A paramagnetic quenching reagent, Mn^{2+}/EDTA (1:22,2), was developed for the purpose of investigating the phospholipid phosphate groupings of human serum low and high density lipoproteins through the quenching effect of the reagent on the ^{31}P nuclear magnetic resonance signals from these complexes. Systems investigated included native low and high density serum lipoproteins (LDL, HDL_2, and HDL_3), egg phosphatidylcholine vesicles together with appropriate phosphodiester model systems, diethyl phosphate in aqueous buffer, and phosphatidylcholine and sphingomyelin both in anhydrous methanol. The results of these studies indicated that ca. 50% of the phospholipid-phosphorus signal of LDL is quenched upon titration as compared to an 80-85% figure observed for HDL_2 and HDL_3. In all cases the spectral effects were totally reversible upon removal of the paramagnetic ion by dialysis. The results of the titration studies indicated a similar but not an identical behavior between HDL_2 and HDL_3. The results are consistent with model structures of HDL and LDL particles derived from low angle X-ray diffraction.

6671 Mechanism of degradation of duplex deoxyribonucleic acid by the recBC enzyme of Escherichia coli K-12. MacKay, V.; Linn, S. (Univ. of California, Berkeley). *J. Biol. Chem.;* **249**: No. 13, 4286-4294(10 Jul 1974).

Reaction intermediates formed during the degradation of duplex DNA by the recBC DNase have been characterized by sedimentation velociy, isopyknic centrigugation, electron microscopy, and susceptibility to various deoxyribonucleases which are specific for single-stranded DNA. It has been concluded that the intermediates are of two classes: (a) duplex molecules with single-stranded tails of several thousand nucleotides at the 3' and the 5' termini and (b) single-stranded fragments several hundred nucleotides in length. To explain the presence of these intermediates, even in synchronized reactions with DNA molecules in molar excess over enzyme, a reaction scheme for the degradation of duplex DNA is proposed. According to this scheme, the DNase unwinds the strands of the duplex from an end and clips off fragments several hundred nucleotides long from one strand, while remaining bound to the terminus of the undegraded strand. When a single-stranded tail of up to several thousand nucleotides is formed in this way, the enzyme switches strands and degrades the tail from its terminus, yielding a

shortened, wholly duplex molecule. The cycle is then repeated until the molecule is entirely digested. The scheme recognizes the processive nature of the degradation of duplex DNA by this enzyme and hypothesizes that the ATP hydrolysis which accompanies DNA degradation is required for the unwinding reaction.

6672 In vitro studies of the gam gene product of bacteriophage λ. Karu, A.; Sakaki, Y.; Echols, H.; Linn, S. (Univ. of California, Berkeley). pp 95-106 of Mechanisms in recombination. Grell, R.F. (ed.). New York; Plenum Publishing Corp. (1974).

About six years have elapsed since it was established that the recB and recC genes of Escherichia coli specify a complex DNase-ATPase, the RecBC enzyme. Although this enzyme has been extensively purified, and a great deal is known of its catalytic properties and its preference for certain forms of DNA in vitro, its biochemical activity in vivo is still unknown. However, considerable evidence has accumulated indicating that this enzyme is antagonistic to the normal pathway for phage lambda DNA replication, and that as a consequence, phage lambda has evolved a means to regulate the RecBC enzyme. The γ-protein of phage lambda is a specific inhibitor of the host RecBC enzyme. The mechanism of inhibition is most likely a direct protein-protein interaction. The inhibitory activity of γ-protein appears to be essential for the normal late stage of lambda replication in vivo. A discussion of the possible biochemical bases for the biological effects is presented.

6673 Extraction and purification of calcium-activated photoproteins from the ctenophores Mnemiopsis sp. and Beroe ovata. Ward, W.W.; Seliger, H.H. (Johns Hopkins Univ., Baltimore). *Biochemistry;* **13**: No. 7, 1491-1499(1974).

Calcium-activated bioluminescent "photoproteins" from the ctenophores Mnemiopsis sp. and Beroue ovata have been isolated by extraction with EDTA and purified 3800-fold and 7800-fold, respectively. The steps consisted of ammonium sulfate and protoamine sulfate treatments, followed by several steps of ion-exchange, gel filtration, and solubility chromatography. The purified photoproteins are virtually homogeneous by the criterion of sodium dodecyl sulfate polyacrylamide gel electrophoresis. Approximately 30,000 adult specimens of Mnemiopsis, totalling more than 600 kg wet wt, yielded 2 mg of purified photoprotein. Mnemiopsis photoprotein has been resolved into two functionally identical forms ("isoproteins"), termed mnemiopsin-1 and mnemiopsin-2, by chromatography on DEAE-cellulose. Berovin, the Beroue photoprotein, chromatographs as a single symmetrical peak under the same conditions.

6674 Properties of mnemiopsin and berovin, calcium-activated photoproteins from the ctenophores Mnemiopsis sp. and Beroe ovata. Ward, W.W.; Seliger, H.H. (Johns Hopkins Univ., Baltimore). *Biochemistry;* **13**: No. 7, 1500-1510(1974).

By methods previously described, the calcium-activated bioluminescent photoproteins were extracted with EDTA from the ctenophores Mnemiopsis sp. and Beroue ovata and then purified extensively. Two forms of the Mnemiopsis photoprotein, mnemiopsin-1 and mnemiopsin-2, and the single Beroue photoprotein, berovin, have been characterized and compared with respect to their physical and spectral properties. Ctenophore photoproteins react in vitro with calcium ions in molar excess of EDTA to produce a rapid flash with first-order decay kinetics. The rates and total light yields of these reactions are differently dependent on pH, temperature, and ionic strength. Mnemiopsin activation is specific for calcium ions. However, under certain assay conditions and at low metal ion concentrations a large number of cations appear to activate mnemiopsin. But at higher concentrations, most of these cations are inhibitors. Among these, only Mg^{2+} and Ba^{2+} are completely reversible competitive inhibitors of bioluminescence. Total photon yields are enhanced by preincubation with certain hydrophilic alcohols but reduced with long-chain aliphatic alcohols. Molecular weights were estimated by gel filtration on Sephadex and Bio-Gel and by polyacrylamide gel electrophoresis in the presence of sodium dodecyl sulfate. The most reliable molecular weight estimates were 24,000, 27,500, and 25,000 awu for m-1, m-2, and berovin, respectively. Physical and spectral similarities among these photoproteins and the bioluminescent systems of the jellyfish Aequorea and the sea pansy Renilla suggest that similar biochemical mechanisms may exist among all of the bioluminescent coelenterates.

6675 recBC deoxyribonuclease of Escherichia coli K-12. Karu, A.E.; MacKay, V.; Goldmark, P.J.; Linn, S. (Univ. of California, Berkeley). *J. Biol. Chem.;* **248**: No. 14, 4874-4884(25 Jul 1973).

The behavior of the recBC DNase of Escherichia coli with a variety of substrates has been investigated. Duplex circular DNA is resistant to digestion, is not a cofactor for the DNA-dependent ATPase, and does not effectively compete for enzyme with substrate DNAs. Treatment of duplex circles with ultraviolet light or x-rays does not render them susceptible to the enzyme nor does nicking with pancreatic DNase. In the latter case the nicks are neither sealed nor translocated. Removal of the phosphomonoester group from a nick has no effect, but localized denaturation or removal of approximately five nucleotides at a nick renders duplex circles susceptible to digestion. The enzyme appears to digest linear DNA by a processive mechanism in which the rate is limited by the initiation of digestion of a molecule. It shows no apparent polarity of degradation, nor does it appear to be affected by the presence or absence of terminal phosphate groups. The original terminal nucleotides are dispersed among all classes of the products in a limit digest, so they do not constitute a special type of product. Linear DNA treated with ultraviolet light or x-rays is degraded by the enzyme, but RNA-DNA hybrid is resistant. The latter substrate can serve as cofactor for the DNA-dependent ATPase, however, effectively uncoupling the two activities. At ATP concentrations of 1 mM or greater the enzyme generates early in the reaction large, sedimentable DNA fragments, as well as nonsedimentable products. The large fragments are primarily duplex, but contain single-stranded regions at 5′ termini and probably at 3′ termini at roughly equal frequency.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 6666

6676 Urinary creatinine excretion and lean body mass. Forbes, G.B.; Bruining, G.J. (Univ. of Rochester School of Medicine and Dentistry, NY). *Am. J. Clin. Nutr.;* **29**: 1359-1366(Dec 1976).

In a group of 34 adult and child subjects a high correlation ($r = 0.988$) was found between lean body mass, as determined by potassium-40 counting, and urinary creatinine excretion. The effect of technical errors was reduced by averaging the results of two or three ^{40}K assays on each subject, and by making consecutive 3-day collections of urine. It appears that one can make a reasonable estimate of lean body mass from urinary creatinine excretion.

6677 Rapid transfer of oxygens from inorganic phosphate to glutamine catalyzed by Escherichia coli glutamine synthetase. Stokes, B.O.; Boyer, P.D. (Univ. of California, Los Angeles). *J. Biol. Chem.;* **251**: No. 18, 5558-5564(25 Sep 1976).

Measurements are reported on certain isotopic fluxes during the net conversion of glutamine, ADP and P/sub i/ to glutamate, NH_3, and ATP by Escherichia coli glutamine synthetase (adenylylated form, Mn^{2+} activated) in presence of a hexokinase/glucose trap to remove the ATP formed during the reaction. The results show that the transfer of oxygens from P/sub i/ to glutamine is the most rapid of the measured isotopic interchanges, over five oxygens from P/sub i/ being transferred to glutamine for each glutamate formed by net reaction. Under similar conditions, the oxygen transfer from P/sub i/ to glutamate, was stimulated somewhat by an increase in the glutamate concentration but inhibited by an increase in the ammonia concentration. The enzyme from brain or peas did not show the rapid transfer of ^{18}O from P/sub i/ to glutamine shown by the E. coli enzyme. Deductions are also made from the data about the availability of the oxygens of γ-carboxyl of bound glutamate for reaction. The most logical explanation of the results with the E. coli enzyme is that the γ-carboxyl group of bound glutamate has sufficient rotational freedom so that under conditions of rapid substrate interconversion either carboxylate oxygen can participate in the reaction. The results with the pea enzyme are consistent with hindered rotation of the γ-carboxyl group of the bound glutamate. Together with previous data, the additional findings make likely a relative order of certain catalytic steps for the E. coli enzyme as follows; ATP release < NH_3 release < glutamate release < substrate interconversion < glutamine release and P/sub i/ release and glutamate release < ADP release.

CYTOLOGY

REFER ALSO TO CITATION(S) 4944, 6657, 6658, 6659, 6664, 6667, 6671, 6672, 6675, 6698, 6708, 6725, 6737, 6754

6678 (BNL—50674, pp 178-196) **Injection of tRNAs into somatic cells: search for in vivo systems to assay potential nonsense mutations in somatic cells.** Celis, J.E. (Aarhus Univ., Denmark). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

It is clear that neither of the two methods of microinjection could be used alone to approach the problem of assaying nonsense mutations. The main problems associated with red-cell-mediated microinjection are that 99 percent of the material is wasted during the two-step transfer procedure and that the fusion conditions must be optimized for each cell type to be used. The direct microinjection technique, although not well suited to biochemistry, has the advantages that small samples are sufficient, the amount of material injected into each cell can be determined, and only the desired material is introduced into the cell. This technique has the limitations

that only cells attached to surfaces can be injected and that an autoradiographic or immunofluorescent method is needed for detecting suppression. However, once a potential mutant has been isolated and tested by direct microinjection, red-cell-mediated injection or in vitro systems can be used for biochemical studies.

6679 Timing of some of the molecular events required for cell fusion induced by herpes simplex virus type 1. Kousoulas, K.G.; Person, S.; Holland, T.C. (Pennsylvania State Univ., University Park). *J. Virol.;* **27**: No. 3, 505-512(Sep 1978).

The timing of some of the molecular events that are required for cell fusion was investigated. Cell fusion was produced by a mutant of herpes simplex virus type 1 that causes extensive cell fusion during infection. The timing of molecular events required for fusion was established by the use of blocking agents. Phosphonoacetic acid blocks viral DNA synthesis; actinomycin D blocks RNA synthesis; cycloheximide blocks protein synthesis; 2-deoxyglucose blocks glycosylation of glycoproteins; high temperature, NH_4Cl, and adamantanone block unknown steps required for cell fusion. For cells infected at a low multiplicity of infection, phosphonoacetic acid decreased the rate but not the final amount of fusion, but at a multiplicity of infection of 10 it had no effect on the rate of cell fusion. RNA synthesis was required for fusion until 4 h after infection, protein synthesis until 5.5 h after infection, and glycosylation until 7 h after infection. The temperature-dependent step occurred before 6 h after infection, whereas NH_4Cl and adamantanone acted at steps that occurred until 8 h after infection. Cycloheximide, temperature, NH_4Cl, and adamantanone acted reversibly; actinomycin D and 2-deoxyglucose acted irreversibly. The same order of action of the inhibitors was also determined by using pairs of inhibitors sequentially. These experiments also indicated that the fusion factor was not an α-polypeptide. Virus growth and cell fusion were both found to be highly dependent on temperature in the range of 30 to 40°C. Wild-type infections are apparently characterized by the presence of a fusion factor inhibitor. The fusion-blocking agents were added to wild-type-infected cells under a variety of conditions in an attempt to selectively block the production of the fusion inhibitor molecule and thereby cause extensive cell fusion. However, fusion was not observed in any of these experiments.

6680 Hairy cell leukemia: an unusual lymphoproliferative disease. A study of 24 patients. Golomb, H.M. (Univ. of Chicago). *Cancer, Suppl.;* **42**: No. 2, 946-956(Aug 1978).

From American Cancer Society-National Cancer Institute national conference on the lymphomas and the leukemias; New York, NY, USA (29 Sep 1977).

A laboratory and clinical evaluation of 24 patients with hairy cell leukemia was carried out over a 23-month period. Most patients had splenomegaly without adenopathy or pancyotpenia. Nine of the patients had undergone splenectomy prior to referral; their median WBC count was 6600/mm³. The median WBC count for the 14 patients who had no prior therapy was 3550/mm³, and their median platelet count was 80,500/mm³. Spleen weights ranged from 618 to 3780 g; there appeared to be no relationship between the size of the spleen and the response in the blood counts after splenectomy. Four patients in whom the majority of the WBC were hairy cells underwent splenectomy, which produced no real change in their WBC count; however, there was improvement in the platelet count in three. In contrast, the presence of leukopenia with a low percentage of hairy cells predicted a beneficial response to splenectomy. The study of surface immunoglobulins (SIg) in 16 patients demonstrated that resynthesis had occurred in each case. Phagocytosis of zymosan was studied in 15 patients; in 8 of these, 25 percent or more of the hairy cells were capable of phagocytosis; in 6 others, 0 to 9 percent; and in one, 13 percent. The existence of either a spectrum of functional capabilities of hairy cells or several distinct subtypes is suggested by these data. A chromosome abnormality was present in 2 of the 19 patients from whom adequate samples were obtained; the abnormality probably involved chromosome 12 in both patients as well as absent Y and was associated with a rapidly progressive clinical course. The presence of a predominant number of hairy cells with a normal or increased peripheral blood WBC count or of a chromosomal abnormality suggests that splenectomy might not be beneficial as the initial therapy and that chemotherapy should be considered.

6681 Regeneration of endoderm by ectoderm isolated from mouse blastocysts. Pedersen, R.A.; Spindle, A.I.; Wiley, L.M. (Univ. of California, San Francisco). *Nature (London);* **270**: No. 5631, 435-437(1 Dec 1977).

Cell determination can be described as the progressive restriction in developmental options during embryogenesis. Mouse embryo cells, in particular, remain undetermined for a relatively long period, and the fate of cells seems to be labile throughout the period of cleavage. Microsurgical analysis of mouse blastocysts, however, has shown that the developmental potential of inner cell mass and trophoblast cells becomes restricted during blastocyst formation, so that neither of these early cell types retains the option of differentiating into the other. It was investigated whether the primary ectoderm, which forms in the inner cell mass on day 5 of gestation, retains the option of differentiating into endoderm. It was found that when ectoderm was isolated from mouse blastocysts by immunosurgery it could regenerate an outer layer of endoderm during further culture. The capacity of isolated ectoderm to differentiate into endoderm depended both on the initial mass of the embryo and on the time that the ectoderm was isolated from the inner cell mass.

6682 Neurochemical properties of cell lines from N-ethyl-N-nitrosourea induced rat tumors. West, G.J.; Uki, J.; Stahn, R.; Herschman, H.R. (Univ. of California School of Medicine, Los Angeles). *Brain Res.;* **130**: 387-392(1977).

Clonal cell lines derived from neural tumors have been used extensively in the recent past to characterize, in molecular terms, nervous system specific biochemical and physiological phenomena. Characteristics of both "neuronal" and "glial" cultures have been described and quantified. The C1300 murine neuroblastoma and its derivatives have been a particularly valuable model for neuronal function. However, this tumor represents only a single spontaneous neoplasm. The establishment of additional "neuronal" cell lines might produce representatives of other neuronal classes in addition to the cholinergic and adrenergic lines described to date. Additional lines of glial-derived cells may also help to elucidate glial function. Administration of ENU to rats results in a high yield of tumors of the central nervous system. Schubert and his colleagues, following such a program, have established a number of cell lines, some of which appear to be neuronal in origin. We previously carried out a similar program, with the addition of NGF as a potential cocarcinogen, in an attempt to direct transformation of neuroblasts of the sympathetic nervous system. Thirty-five cell lines were established and cloned in our laboratory. We report here some biochemical and physiological characteristics of these cell lines. Our initial objective was to attempt to distinguish neuronal from non-neuronal cells. Since the action potential Na^+ ionophore is present in cells with electrically excitable membranes, we felt assay for this property would provide us with an excellent initial screen. We utilized the method of Catterall and Nirenberg, which examines tetrodotoxin-inhibitable veratridine-dependent Na^+ transport, as an assay for the action potential Na^+ ionophore in all 35 cell lines.

6683 Subribosomal particles of cultured Chinese hamster cells. Identification of ring-shaped structures with 21S protein particles. Enger, M.D.; Okinaka, R.T. (Los Alamos Scientific Lab., NM). *Exp. Cell Res.;* **104**: 247-254(1977).

The relationship of protein and ribonucleoprotein 18--21S subribosomal particles to 120 A ring-shaped structures was determined. Such structures were found to be co-sediment with the 21S protein particle and to concentrate with this particle during purification. Resolved 21S particles freed of 18S particles. LMM--RNPs, and 20S tRNP were shown to be comprised mainly of four or more proteins having molecular weights in the range of 22000-28000 D. Such proteins are completely absent from resolved 18S protein particles.

6684 Bactericidal mechanisms of the granulocyte. Spitznagel, J.K. pp 103-131 of Granulocyte: function and clinical utilization. New York; Alan R. Liss, Inc. (1977).

Antimicrobial action of polymorphonuclear leukocytes depends on an array of substances carried in their cell membranes and cytoplasmic granules. These substances mediate killing in several systems. Some depend on molecular oxygen while others are independent of it. Some of the systems that depend on oxygen also require myeloperoxidase. The different systems seem able to act in primary or in reserve capacities backing each other up in times of stress or failure. Thus a deficiency in one system does not necessarily leave the polymorphs completely incapable of antimicrobial action although impairment may be severe as in chronic granulomatous disease. In general a poorly functioning polymorph is better than no polymorph at all.

6685 Arginine-rich cationic proteins of human eosinophil granules. Olsson, I.; Venge, P.; Spitznagel, J.K.; Lehrer, R.I. (Univ. of Lund, Sweden). *Lab. Invest.;* **36**: No. 5, 493-500(1977).

Several arginine-rich cationic proteins previously isolated from granules of leukemic myeloid cells have been found to reside primarily in human eosinophil leukocytes. The major component has a molecular weight of 21,000 and it contains approximately 2.6 moles of zinc per mole of protein. Velocity centrifugation of cytoplasm from leukocytes of patients with marked eosinophilia showed that this group of proteins is packaged in the crystalloid-containing large eosinophil granules. Approximately 30% of the protein content of eosinophil granules belonged to this group of cationic proteins. Bactericidal or esterolytic activities of the cationic proteins were not detected, nor did they inhibit guinea pig anaphylatoxin or histamine-induced contraction. The basic protein previously demonstrated in guinea pig eosinophils may be analogous to the group of basic

proteins of human eosinophils but great differences are found for molecular weight and amino acid composition.

6686 Membrane-bound ATPase of intact vacuoles and tonoplasts isolated from mature plant tissue. Lin, W.; Wagner, G.J.; Siegelman, H.W.; Hind, G. (Brookhaven National Lab., Upton, NY). *Biochim. Biophys. Acta;* **465**: 110-117(1977).

Intact vacuoles were isolated from petals of Hippeastrum and Tulipa (Wagner, G. J. and Siegelman, H. W. (1975) Science 190, 1298 to 1299). The ATPase activity of fresh vacuole suspensions was found to be 2 to 3 times that of protoplasts from the same tissue. 70 to 80% of the ATPase activity of intact vacuoles was recovered in tonoplast preparations. The antibiotic Dio-9 at 6 $\mu g/10^6$ vacuoles or protoplasts causes 40% inhibition. However, only the protoplast ATPase is sensitive to oligomycin. N,N'-dicyclohexylcarbondiimide (DCCD) slightly stimulates ATPase activity in both vacuole and protoplast suspensions, whereas ethyl-3-(3-dimethylaminopropyl carbodiimide) (EDAC) strongly inhibits. Spectrophotometric studies show that in the petal the vacuolar contents have a pH of 4.0 for Tulipa and 4.3 for Hippeastrum, whereas the intact isolated vacuole has an internal pH of 7.0 (in pH 8.0 buffer) for Tulipa and about 7.3 for Hippeastrum. Internal ion concentrations of 150, 46, 30, 30 and 6 mM were found for K^+, Na^+, Mg^{2+}, Cl^-, and Ca^{2+} respectively, which are about the same as those in protoplasts.

6687 Differential inhibition of trophoblast outgrowth and inner cell mass growth of actinomycin D in cultured mouse embryos. Glass, R.H.; Spindle, A.I.; Pedersen, R.A. (Univ. of California, San Francisco). *J. Reprod. Fertil.;* **48**: 443-445(Nov 1976).

Treatment of preimplantation mouse embryos in vitro with 10^{-3} to 10^{-1} μg actinomycin D/ml for 2 hr showed that (i) postimplantation development in vitro was inhibited most when embryos were treated at the morula stage and (ii) after the morula stage actinomycin D inhibited trophoblast outgrowth less than inner cell mass development.

6688 Mechanism of estrogen action on gene expression at the level of translation. Sharma, O.K.; Borek, E. (Univ. of Colorado Medical Center, Denver). *Cancer Res.;* **36**: 4320-4329(Nov 1976).

One of the earliest events following the administration of estradiol to ovariectomized rats is an increase in transfer RNA (tRNA) methyltransferase activity of the uterus. Ovariectomy diminishes by about one-half the capacity of extracts of uteri to introduce methyl groups in vitro into heterologous tRNA. Administration of estradiol to ovariectomied animals restores the tRNA methyltransferase capacity to normal. Alterations in the population of uterine serine tRNA were also observed following ovariectomy. These findings represent reversible qualitative changes produced by a hormone in the target tissue. Whether the tRNA's are involved in regulating hormone-induced protein synthesis was investigated by studying the estrogen-induced ovalbumin synthesis in immature chick oviducts. tRNA's from oviducts of estrogen-stimulated chicks or from oviducts of laying hens produced an enhanced simulation of ovalbumin synthesis in vitro compared with tRNA's from oviducts of immature chicks that were withdrawn from estrogen stimulation (these chicks do not synthesize ovalbumin). Some of these hormone-induced alterations may be of importance in understanding the molecular mechanisms of estrogen action on gene expression. During these studies, we have observed a novel effect of the administration of the carcinogen, ethionine, in the immature chicks. Ethionine induces ovalbumin and conalbumin synthesis in immature chick oviducts that were withdrawn from estrogen for 3 to 4 weeks following primary estrogen stimulation.

6689 Modulation of the synthesis in vitro of a hormone-induced protein by transfer RNA. Sharma, O.K.; Breezley, D.N.; Borek, E. (Univ. of Colorado Medical Center, Denver). *Nature (London);* **262**: No. 5563, 62-63(1 Jul 1976).

Estrogens are known to have multiple effects on target tissues. In the chick oviduct they can stimulate accumulation of specific mRNA, tRNA, tRNA methyltransferases, polysomes, endoplasmic reticulum and factors essential for translation. The findings presented here imply that the relative inefficiency of oviduct tRNA from withdrawn chicks in ovalbumin synthesis may be due to a deficiency in the population of tRNAs. The validity of such an assumption can be probed experimentally because the oviduct of the laying hen offers an abundant source of tRNAs which have a high efficiency of translation.

6690 Induction of ovalbumin and conalbumin synthesis in immature chick oviducts by ethionine. Sharma, O.K.; Borek, E.; Martinez-Hernandez, A. (Univ. of Colorado Medical Center, Denver). *Nature (London);* **259**: No. 5544, 588-591(19 Feb 1976).

Prolonged feeding of rats with ethionine results in a high frequency of hepatic carcinoma. Ethionine induces other pathological manifestations in other organs and tissues of experimental animals, and some of its effects can be reversed rapidly by the administration of methionine. At the molecular level ethionine induces a rapid decrease in hepatic ATP concentration, followed by inhibition of RNA and protein synthesis. The decrease in ATP concentration is due to formation of S-adenosyl-ethionine, and inhibitor of tRNA methyltransferases, and so tRNA isolated from the liver of rats injected with adenine and ethionine is hypomethylated. It is well established that several eukaryotic mRNAs are methylated on the 5' terminus and that such modification is essential for translation. To study the mechanism of methylation we attempted to produce a specific methyl-deficient mRNA by the administration of ethionine. To monitor the effectiveness of the deprivation of methyl groups the synthesis of hormone-induced ovalbumin in immature chick oviducts was followed. Administration of estrogen to immature chicks causes cytodifferentiation and growth of the primitive oviduct. The tubular gland cells synthesize ovalbumin, conalbumin, ovomucoid and lysozyme which comprise 85-90% of the egg-white proteins. The continuous presence of estrogen is required for sustained synthesis of these proteins in immature chicks; withdrawal of estrogen is accompanied by a gradual decline in cell-specific protein synthesis as well as in the weight of the oviduct and the RNA content of the tissue.

6691 Replicon size and rate of fork ovement in early S of higher plant cells (Pisum sativum). Van't Hof, J. (Brookhaven National Lab., Upton, NY). *Exp. Cell Res.;* **103**: 395-403(1976).

Measurements of chromosomal DNA fiber replication of cells of cultured pea root meristems in early S via autoradiography showed a 3-fold increase in rate of fork movement in the first 2 h. The initial rate was 4.5 to 6 $\mu m\ h^{-1}$ but forks active after 90 min moved at nearly 18 $\mu m\ h^{-1}$. The faster movement was not characteristic of all replicons. Certain fibers consisted of replicons of a smaller mean size (38 to 42 μm) with slowly moving forks (4.5 to 6 $\mu m\ h^{-1}$ fork $^{-1}$) and others had replicons almost 50 μm long with forks that moved more rapidly.

6692 Compositional studies of myofibrils from rabbit striated muscle. Etlinger, J.D.; Zak, R.; Fischman, D.A. (Univ. of Chicago). *J. Cell Biol.;* **68**: 123-141(1976).

The localization of high-molecular-weight (80,000-200,000-daltons) proteins in the sarcomere of striated muscle has been studied by coordinated electron-microscopic and sodium dodecyl sulfate (SDS) gel electrophoretic analysis of native myofilaments and extracted and digested myofibrils. Methods were developed for the isolation of thick and thin filaments and of uncontracted myofibrils which are devoid of endoproteases and membrane fragments. Treatment of crude myofibrils with 0.5% Triton X-100 results in the release of a 110,000-dalton component without affecting the myofibrillar structure. Extraction of uncontracted myofibrils with a relaxing solution of high ionic strength results in the complete disappearance of the A band and M line. In this extract, five other protein bands in addition to myosin are resolved on SDS gels: bands M 1 (190,000 daltons) and M 2 (170,000 daltons), which are suggested to be components of the M line; M 3 (150,000 daltons), a degradation product; and a doublet M 4, M 5 (140,000 daltons), thick-filament protein having the same mobility as C protein.

GENETICS

REFER ALSO TO CITATION(S) 6645, 6648, 6655, 6672, 6678

6693 (BNL—50674) **Genetic interaction and gene transfer.** Anderson, E.W. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Mar 1978. Contract EY-76-C-02-0016. 393p. (CONF-770576—). NTIS.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

Separate abstracts were prepared for 28 papers presented at the conference. Author and subject indexes are included. (HLW)

6694 (BNL—50674, pp 1-15) **Genes for plastid ribosomal proteins and RNAs.** Bogorad, L. (Harvard Univ., Cambridge, MA); Bedbrook, J.R.; Davidson, J.N.; Hanson, M.R.; Kolodner, R. Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Genes for proteins of chloroplast ribosomes in the alga Chlamydomonas reinhardi and genes for chloroplast RNAs in Zea mays were investigated. Questions raised by the data provoked speculation on the origin and evolution of eukaryotic genomes. Genes specifying proteins of the large subunit of the chloroplast ribosome may be identified through further analysis of known mutants. Genes for some ribosomal proteins of chlamydomonas chloroplasts are located in the nuclear genome and at least one in the chloroplast genome. Genes for the rRNAs of maize chloroplasts have been located on the maize chloroplast genome. Mechanisms for gene dispersal and barriers and limits to gene dispersal are discussed. (HLW)

6695 (BNL—50674, pp 16-35) **Mitochondrial and nuclear gene interaction in HeLa cells.** Attardi, G.; Costantino, P.; England, J.M.; Lynch, D.; Ojala, D.; Posakony, J.W.; Storrie, B. (California Inst. of Tech., Pasadena). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The evidence indicates that the replication and expression of the mitochondrial genome in exponentially growing mammalian cells are under tight control by nuclear gene products. This control ensures that the mit-DNA complement and the mitochondrial protein-synthesizing capacity per cell, under steady-state growth conditions, increase in proportion to the cell mass. Almost nothing is known about the regulatory mechanisms involved. The study of the cell cycle dependence of mitochondrial macromolecular syntheses has not distinguished between positive and negative regulatory signals; in contrast, the effects of blocking cytoplasmic protein synthesis or of enucleation on mitochondrial DNA or RNA synthesis have pointed to some kind of positive control. The observation of a transient stimulation of the rate of mitochondrial protein synthesis in enucleated cells has, on the other hand, suggested a possible negative control by the nucleus in this process, but this interpretation needs to be confirmed by other approaches. The replication and expression of the mitochondrial genome are normally coordinated with those of the nuclear genome, but an increasing amount of evidence suggests that this coupling can be interrupted in abnormal situations. Thus, under conditions of unbalanced growth or of metabolic perturbations the mitochondrial genome can be replicated in the absence of nuclear DNA replication, for example, in cells in the stationary phase, or in mitotically arrested cells, or during thymidilate starvation in the presence of exogenous thymidine in cells deficient in cytoplasmic thymidine kinase activity but with persistent mitochondrial thymidine kinase activity.

6696 (BNL—50674, pp 36-49) **Transfer, maintenance, and expression of bacterial ti-plasmid DNA in plant cells transformed with A. tumefaciens.** Schell, J.; Van Montagu, M. (State Univ., Ghent). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The mechanism of induction of the plant cancer crown gall by Agrobacterium tumefaciens has been briefly described. Large plasmids of molecular weight (100 to 150) x 10^6, called Ti-plasmids, are essential to the transformation process. Ti-plasmids carry a DNA segment that can be transferred to, and maintained and expressed in, transformed plant cells. This DNA segment has been identified both by direct hybridization experiments between Ti DNA fragments and crown gall DNA and by the study of a deletion mutant of a Ti-plasmid. Indirect evidence suggests that genes involved in the synthesis of abnormal amino acids (such as octopine and nopaline) by crown gall cells, and known to be carried on the Ti-plasmids, are in fact located on the DNA segment that is transferred to the plant cells. Ti-plasmids are efficient conjugative plasmids, since they can promote their own transfer by conjugation to various plasmic-free bacterial strains. Their conjugative properties may be involved also in the Ti DNA transfer from Agrobacterium to plant cells. Preliminary evidence indicates that the transferable segment of the Ti-plasmid has the structure of a transposon, since it appears to be flanked by a sequence exhibiting most of the properties of the sequences that border the known bacterial drug-resistance gene transposons.

6697 (BNL—50674, pp 62-81) **RNA-mediated manipulation of early chick embryonic gene functions in vitro.** Siddiqui, M.A.Q.; Deshpande, A.K.; Arnold, H.H.; Jakowlew, S.B.; Crawford, P.A. (Roche Inst. of Molecular Biology, Nutley, NJ). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

In spite of several examples of both RNA and proteins as candidates for regulatory elements in gene expression, there is no clear definition of their role in normal cellular processes. The finding that the 7 S chick embryonic heart-RNA (fraction 1a) can produce a specific mode of change characteristic of the embryonic cardiogenic process offers the first opportunity to test the role of an RNA in communication of regulatory information in an experimentally analyzable biological system. Our present experiments are designed to investigate whether the 7 S RNA can be detected in measurable amounts at relevant stage(s) and areas in the chick embryo during development so that the physiological role of the RNA in heart induction can be understood.

6698 (BNL—50674, pp 82-95) **Teratocarcinoma cells as vehicles for mutant and foreign genes.** Mintz, B. (Fox Chase Cancer Center, Philadelphia). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Mouse malignant teratocarcinoma cells, upon injection into early embryos at the blastocyst stage, become integrated into the developing embryo and stably normalized. In the mosaic mice that are formed, tumor-derived cells can give rise to the full range of normal, functional somatic tissues, and also to germ cells from which progeny are obtained. Totipotent mouse teratocarcinoma cells thus provide a new and essentially parasexual means of generating entire animals. The advantages of in vitro and in vivo technologies can now therefore be combined to synthesize mice with experimentally useful mutations. After mutagenization of the teratocarcinoma cells in culture, and selection or screening for the desired mutant phenotype, cells of mutant clones are microinjected into genetically marked blastocysts for further differentiation and full gene expression within the framework of the organism. An example is the isolation, by 6-thioguanine resistance, of cells deficient in hypoxanthine-guanine phosphoribosyl transferase—the same deficiency that characterizes human patients with the X-linked Lesch-Nyhan disease. In work in progress, these cells have been cycled into genetically marked blastocysts, where the tumor lineage has successfully given rise to fully differentiated tissue contributions in which the enzyme defect persists. Such experiments present numerous possibilities for introducing specific mutations into mice, toward the ends of studying gene mechanisms responsible for differentiation and of producing animal models of human genetic diseases. Teratocarcinoma cells may also serve as vehicles for introducing foreign genetic material into mice in order to facilitate analyses of gene control mechanisms in development and disease.

6699 (BNL—50674, pp 96-105) **Somatic cell genetic analysis of gene transfer in mammalian cells.** Ruddle, F.H.; Fournier, R.E.K. (Yale Univ., New Haven). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Donor chromosomes are ingested by phagocytosis and degraded in lysomes. The chromosomes are processed to small fragments, some of which presumably escape the lysosomes and set up residence in some other cellular compartment. The location of the unstable (unintegrated) transgenome is not yet established, but, in view of its subsequent integration into host-cell chromosomes, the nucleus is a likely location. The transgenome has a size only roughly defined by experiment, the values ranging between 2 x 10^3 and 1 x 10^6 nucleotide base-pairs; whether it is linear or circular is not known. Basically, it must contain a selectable gene (SG) and a replication initiation site (RIS). Possibly the minimal size of the transgenome is governed by the distance between the SG and RIS regions. The unstable transgenome presumably lacks centromere function and is not integrated. As proposed above, a finite probability exists at each host-cell division for loss of the transgenome by one of the daughter cells. This also implies that multiple copies of the transgenome will occur in some cells. The distribution of copies per cell will be determined by the replication rate of the transgenome in relation to the division rate of the host cells and other factors.

6700 (BNL—50674, pp 106-115) **Nuclear transplantation and gene injection in amphibia.** Gurdon, J.B. (Medical Research Council Lab. of Molecular Biology, Cambridge, Eng.). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The introduction of genetic material into living cells is very efficiently achieved by injection. In general, nucleic acids do not enter cells at all readily, and only a very small fraction of the DNA molecules outside a cell can be made to enter it, after extensive incubation of the DNA under conditions such that it is readily degraded. The large size of amphibian eggs and oocytes permits about 10^9 molecules of gene-sized DNA, dissolved in an EDTA-containing sterile saline solution, to be introduced immediately, bypassing the cell penetration step. Our oocyte injection experiments have shown that there is no efficient mechanism by which DNA in the cytoplasm penetrates into the nucleus. Probably entry into the nucleus happens most readily when cells divide, the introduced DNA being included in reconstituting telophase nuclei. It is an important but as yet unanswered question whether viral DNA in the form of a nucleoprotein complex has specially facilitated passage into interphase nuclei. One of the most encouraging results of our egg injection work is that injected DNA is remarkably stable. As judged by hybridization tests, more than 10 percent of the DNA injected into fertilized eggs could still be detected in tadpoles several days later.

6701 (BNL—50674, pp 116-126) **Chromosome-mediated gene transfer with resultant expression and integration of the transferred genes in eukaryotic cells.** McBride, O.W.; Athwal, R.S. (National Cancer Inst., Bethesda, MD). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The transfer of functional genes can be demonstrated following incubation of eukaryotic cells with isolated metaphase chromosomes. The frequency of transfer of any specific marker is quite low, in the range of 10^{-7}, for most markers in most laboratories. The total frequency of transfer of functional genes is estimated to be about 1000-fold higher. Stable transfer involves only a chromosome fragment, but closely linked genes are cotransferred. The size of the transgenome probably is in the range of 0.1 to 1 percent of the donor genome. Although this value is not yet well established. Transfer probably occurs by phagocytosis, and most subsequent details of this process are quite speculative. The transferred genetic material can exist in at least two states in recipient cells. In the first (unstable) state, there is a high frequency (about 10^{-1} per cell per generation) of loss of the transferred genes, accompanied by a much lower frequency (about 10^{-8} per cell per generation) of stabilization of these genes. It seems extremely likely that initial events do not require integration of the transgenome into the DNA of the transgenote. The means for preservation of this acentric fragment prior to stabilization is still unclear. There is reasonably strong evidence that stabilization does result from integration, and that this probably occurs at multiple sites.

6702 (BNL—50674, pp 127-134) **Genetic analysis by chromosome-mediated gene transfer in hamster cells.** Spandidos, D.A.; Siminovitch, L. (Univ. of Toronto). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

We have examined the transfer of a variety of markers by CHO metaphase chromosomes. The studies described here show that dominant markers can be transferred at relatively high frequency, and that the technology can be used to examine linkage of appropriate markers and to transfer markers associated with the transformed phenotype. Frequencies of transfer seem to be higher than those found in other studies. This may be due to improvements in technique or to the particular markers we used. The latter explanation seems unlikely since our efficiency of transfer is similar for a variety of markers such as Mtx/sup RIII/, Ga^+, $GlyB^+$, $GlyA^+$, and the Aga^+ phenotype. Although experiments involving genes controlling enzymes in the folate pathway show linkage of these markers, they do not provide information on how contiguous the genes are or whether they constitute an operon. Such information will come only from further analysis of the system biochemically and genetically. Our work on the transfer of the capacity for anchorage independence indicates one major potentiality of the chromosome transfer technology. It may be possible eventually to study other phenotypes of the transformed cell in similar ways. The technology should also facilitate study of the biochemical alterations that occur concomitantly with the transfer of any given cancer phenotype. The chromosome transfer technology described here, together with other advances, such as the use of DNA and the use of micronuclei containing one or few chromosomes, should eventually provide the same possibilities for analysis of gene function in eukaryotes that have been available in bacteria for a number of years.

6703 (BNL—50674, pp 135-146) **HPRTase expression in mouse gene transferents.** Degnen, G.E.; Miller, I.L.; Adelberg, E.A.; Eisenstadt, J.M. (Yale Univ., New Haven). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The initial event of gene transfer is a rare productive interaction between chromosome and cell (occurring in this system at a frequency of approximately 1 in 10^7 recipient cells) which yields the transferent. The gene is unstably inherited at this point, and this unstable state is associated with overproduction of the gene product in our strain. Three fates are now known for the transferent. The most common is replication and division to yield two essentially unchanged cells. This state has been maintained in continuous culture for up to 100 generations. The next most probable fate at the transferent is total loss of gene expression, which occurs at various rates, approximately 0.1 per cell per generation. Exponential decay curves are consistent with the interpretation that the loss process is truly random. The final possible fate is stabilization of the gene, correlated with return of its gene product to near normal levels. This is a rare event, whose rate we estimate to be of the order of 10^{-8} per cell per generation. Despite the rarity of the event, stabilized transferents routinely are recoverd after prolonged growth in selective medium. The constant wastage by unstable transferents (approximately 10 percent of their progeny at each division) appears to provide the necessary growth advantage by which the initial rare stable transferent takes over the population.

6704 (BNL—50674, pp 147-160) **Mechanisms of DNA uptake by cells.** Lacks, S.A. (Brookhaven National Lab., Upton, NY). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The highly transformable bacteria have evolved elaborate mechanisms for DNA uptake, apparently as a means of genetic exchange. We cannot expect mammalian cells to have developed such mechanisms. However, the experience with E. coli has shown that, with sufficient search, conditions can be found that will introduce significant amounts of DNA into ordinary bacterial cells. This should encourage the empirical search for conditions that favor DNA uptake by mammalian cells. One suggestion, derived from the E. coli experience, would be to test the effect of temperature shifts. Such shifts could alter membrane properties so as to facilitate the uptake of DNA. Another approach to increasing the biological effectiveness of added DNA would be to reduce degradation by cellular nucleases. Cell lines could be readily screened for nuclease content by the technique described above. Cell lines which were generally low in nucleases, or perhaps lacking one that was particularly obnoxious, could be chosen as recipients of DNA in transformation experiments. It might also be possible to obtain mutants that lacked nucleases, perhaps by adapting the screening procedure for bacterial mutants that was mentioned above. Mammalian cells can now be transformed by cellular genetic markers in intact chromosomes and by viral markers in purified DNA. Empirical improvement of DNA entry into the cell and rational elimination of nucleolytic hazards should allow, before long, sufficient entry of biologically intact material so that the transfer of chromosomal genes could be accomplished with purified mammalian DNA.

6705 (BNL—50674, pp 161-165) **Gene transfer experiments in neurospora.** Mishra, N.C. (Univ. of South Carolina, Columbia). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The following topics are discussed: review of original gene transfer experiment in Neurospora; biochemical and genetic characteristics of the allo-induced transformants; relations between growth conditions and DNA uptake; and involvement of a nuclease in genetic transformation in Neurospora. (HLW)

6706 (BNL—50674, pp 166-177) **Transformation of cultured cells to chloramphenicol resistance by purified mammalian mitochondrial DNA.** Coon, H.G.; Ho, C. (National Cancer Inst., Bethesda, MD). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The following topics are discussed: chloramphenicol selection; the nuclear DNA control; potential for analysis of the mechanism of transformation to chloramphenicol-resistant (CAP/sup R/) from chloramphenicol-sensitive (CAP/sup S/) cells by DNA; stability of the transformed phenotype; and some possible future applications of mt-SNA transformation. The findings described in this paper confirm the finding that cytoplasmic fragments (cytochalasin B "cytoplasts"are sufficient to transfer CAP/sup R/ to CAP/sup S/ cells and extend the observations from intraspecies transfer to transfer between closely related species and subspecies of mouse. Evidence is also presented that the purified mt-DNA from CAP/sup R/ cells is able to transmit CAP/sup R/ to CAP/sup S/ cells efficiently. The combination of these results should enable us to define the molecular events associated with the transfer of CAP/sup R/ by mt-DNA alone and to detect and map recombinants occurring within whole-cell hybrids and cytoplast hybrids ("cybrids") made between different mouse subspecies.

6707 (BNL—50674, pp 197-206) **Simian virus 40 gene expression in permissive, nonpermissive, and virus-resistant cells.** Graessmann, A.; Graessmann, M.; Mueller, C. (Free Univ., Berlin). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Nonpermissiveness or resistance to SV40 infection seems to be imposed on the respective cells by restriction of very early event(s) in the infection cycle taking place at the cell membrane. This barrier can be overcome by microinjection of viral DNA into nonpermissive mouse cells or resistant rat myotubes. That microinjection of full virus particles also leads to expression of viral genes in both cell types indicates that the restriction occurs during an event earlier than decapsidation of the virus: adsorption, penetration, or intracellular release of virus. Late SV40 gene expression requires efficient synthesis of the virus-coded T-antigen. In both nonpermissive mouse cells and permissive monkey cells V-antigen synthesis is demonstrable only if a threshold amount of intranuclear T-antigen is obtained. In monkey cells this threshold concentration is observed after microinjection of 1 to 2 SV40 DNA molecules, whereas mouse cells require at least 250 to 500 DNA molecules. It remains open

why these different cell types support early viral gene expression with different efficiencies: in nonpermissive mouse cells the mere production of T-antigen may be less efficient; a biologically important modification step may be impaired; turnover of T-antigen may be increased. Late SV40 gene expression requires, in addition, the onset of viral DNA replication, which in turn seems to be induced by T-antigen accumulation. Our data indicate that late viral gene transcription depends on the availability of a template structure which is generated during the process of viral DNA replication: late template specificity may be given by single-stranded regions or even single nicks at sites still to be determined within the viral genome.

6708 (BNL—50674, pp 207-217) **Papovaviruses as vehicles for the transduction of foreign genes into mammalian cells.** Upcroft, P.; Ziemer, F.; Skolnik, H.; Fareed, G.C. (Univ. of California, Los Angeles). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

These studies show that both the SV40 vector and bacterial DNA sequences remain associated with transformed rat embryo cells and persistently infected monkey kidney cells. In the two transformed rat embryo lines tested, the bacterial sequence is totally conserved. An unexpected observation with the rat cells has been the presence of both free or unintegrated and integrated hybrid viral DNA sequences. These results are in contrast to those of Botchan et al., who detected only integrated SV40 DNA sequences in different cloned lines of SV40-transformed rat cells. The presence of the E. coli su^+ III DNA sequences in the late gene region of SV40 and a weakly permissive host-cell milieu for such a recombinant DNA may account for our findings. Both these host-cell vector systems have two advantages over the lytic infectious system for SV40: (1) no infectious virus is produced (assessed by cocultivation with permissive monkey cells) and (2) the size of the nonviral, prokaryotic or eukaryotic DNA inserted into the late gene region of the SV40 vector may be quite large since no requirement for encapsidation into progeny virus is imposed. Furthermore, expression of the newly introduced gene(s) can be followed in a long-term, stable cell system, unlike the case of a lytic infection, which generally terminates the viability of the host cell prematurely.

6709 (BNL—50674, pp 218-232) **Transposition of DNA sequences.** Bukhari, A.I. (Cold Spring Harbor Lab., NY). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Transposable genetic elements are discussed with regard to 15 elements; transposons; integration-excision of transposable elements; and mechanisms of transposition. The transposable element, bacteriophage mu, is discussed with regard to structure of mu DNA; integration-excision of mu; and mechanism of mu insertion. The bacteriophage mu and transposable elements do not follow the classic integration-excision mode of lambda in any simple manner and may constitute a class of elements different from most temperate phages. (HLW)

6710 (BNL—50674, pp 233-242) **Interconversion of mating type in S. cerevisiae and the cassette model for gene transfer.** Hicks, J. (Cornell Univ., Ithaca, NY); Strathern, J.N. (Cornell Univ., Ithaca, NY). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The cassette model of homothallic interconversion of mating type proposes the insertion of copies of regulatory genes into a locus which allows their expression. In this model, interconversion is the result of the replacement of one cassette of DNA at the mating-type locus with another cassette containing the DNA coding for the alternative mating-type allele. It is proposed that cassettes containing the MATa allele are located at the HMα and hma loci, while MATα cassettes are located at HMa and hmα. The cassette hypothesis proposes a mechanism for generating alterations of cell type which may be applied to the control of differentiation in higher eukaryotes. Because the expression of a gene activated by this mechanism does not require the continued presence of the activating factors, transiently present signals can result in mitotically heritable alterations of cell type. A series of differentiation steps could be controlled by a sequence of cassette insertions in which each cassette would specify its replacement by a cassette containing regulators of the next cell type. Finally, the cassette insertion mechanism can be stable in some circumstances and reversible in others, allowing cells in the germ line to utilize this mechanism without generating meiotically heritable alterations of the genome.

6711 (BNL—50674, pp 243-246) **Mobile suppressor gene in yeast.** Laten, H.; Gorman, J.W.; Bock, R.M. (Univ. of Wisconsin, Madison). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Gene transposition in Saccharomyces cerevisiae has recently been reported. The evidence is based on genetic analyses of a dominant suppressor gene, SUP/sub I-16/, isolated in our laboratory. The product of the gene exhibits the same spectrum of suppression as a class of strong UAA suppressors described in yeast. These suppressors insert tyrosine in response to the UAA condon, and recent studies have confirmed that they code for altered tyrosine tRNAs. The SUP/sub I-16/ gene is capable of changing positions on the genetic map at high frequency. Transpositions to and from chromosome III have been described, as has the transposition to chromosome VI near SUP 11. In this report, further evidence for transposition is detailed, and data relating to other characteristics are presented.

6712 (BNL—50674, pp 247) **Integration and excision of SV 40 viral DNA in mammalian chromosomes.** Botchan, M.; Weirich, S.; Topp, B. (Cold Spring Harbor Lab., NY). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Restriction enzyme cleavage maps of integrated SV40 viral sequences show that SV40 can be attached to cell chromosomal DNA at various points on the viral chromosome and at multiple chromosomal sites. The viral chromosome is stable in that loss of viral DNA, or mutations within the cell DNA surrounding the virus, are not detectable after continued passage of the transformed cells or by the formation of tumors in animals. Spontaneous changes in the DNA, however, do occur at some frequency, and such cells can be screened by classical reversion selection techniques. Revertants of one well studied cell line arise at a frequency of one in 10^4 cells. A large fraction of the revertant clones have lost the SV40 chromosome completely, and others have suffered a deletion in part of the viral DNA. None of these revertants are producing any of the early viral A gene product, T antigen. Retransformation of these revertants and of tsA-transformed cell lines grown at high temperature with superinfecting SV40 DNA will shed some light on the role of homologous DNA recombination in SV40 insertion. When transformed cells are fused with monkey cells, SV40 DNA finds its way out of the transformed cell chromosome and starts to replicate in the nonpermissive nuclei of the heterokaryon.

6713 (BNL—50674, pp 248-271) **Genetic engineering as an adaptive strategy.** Reanney, D.C. (Lincoln Coll., Canterbury, N.Z.). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

This paper presents a bird's-eye view of the role of extrachromosomal elements in adaptive genetics. It is prefaced by some brief remarks concerning the origin of new nucleotide sequences in DNA. These are followed by a discussion of DNA translocation at the two levels documented in microbial systems: the transposition of DNA between replicons in a single cell and the movement of DNA between cells. With these data as a base, an attempt is made to extrapolate some of the lessons learned from bacterial systems to the genetics of plant and animal cells.

6714 (BNL—50674, pp 272-276) **Mechanism of translocation in bacteria.** Novick, R.P. (Public Health Research Inst., New York). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Intensive studies in many laboratories during the past several years have brought to light and thoroughly characterized a novel type of genetic element variously referred to as a transposon, a transposable element, a translocation sequence, a translocon, a translocatable element, etc. In general, such elements consist of an antibiotic-resistance gene of the type usually associated with plasmids, flanked by two identical or very similar nucleotide sequences that are usually but not always inverted with respect to one another. As their various names are intended to indicate, these elements translocate from one site to another within a (bacterial) cell, sometimes causing insertional inactivation of local gene functions. In this note, the salient features of the translocation process are summarized, and a very preliminary hypothesis for its mechanism is suggested.

6715 (BNL—50674, pp 277-296) **Expression of cloned eukaryotic DNA in prokaryotes.** Carbon, J.; Ratzkin, B.; Clarke, L.; Richardson, D. (Univ. of California, Santa Barbara). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

There are no significant barriers preventing the functional expression of many yeast genes in E. coli. In those cases where expression is quite low-level or inefficient, clonal variants can be easily isolated that are capable of expressing the foreign gene at very high levels. The exact nature of this observed increase in functional enzyme capacity is unclear, although in all the cases described here the genetic alteration has occurred at the level of plasmid, rather than cellular, DNA. The increased enzyme activities seen in extracts could be due to increased gene dosage (plasmid copy number); to increased levels of transcription from the cloned gene; to genetic alterations resulting in more efficient or more accurate translation of the "foreign" mRNA by the bacterial protein synthesis machinery; or to mutations in the cloned gene resulting in an enzyme with higher turnover number. The ready facility with which restructuring of the cloned foreign DNA segment occurs, resulting either in higher or lower levels of enzyme expression, is significant from at least two points of view. Apparently, small deletions, insertions, or other rearrangements in the cloned DNA are occurring with fairly high frequency. This introduces an obvious problem for studies of eukaryotic gene structure based on the analysis of DNA segments cloned in E. coli; selective pressure introduced by the expression of a gene on the cloned DNA segment could easily result in the isolation of a variant containing significant alterations of structure within the cloned DNA. Clearly, any foreign DNA segment cloned in E. coli must be compared with the analogous segment isolated without selective pressure for functional expression before meaningful gene structure-function studies can be carried out.

6716 (BNL—50674, pp 297-308) **Expression of the structural gene for catabolic dehyroquinase of Neurospora crassa in Escherichia coli K12.** Kushner, S.R.; Hautala, J.A.; Jacobson, J.W.; Giles, N.H.; Vapnek, D. (Univ. of Georgia, Athens). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

In Neurospora crassa, the qa gene cluster controls the first three reactions in the inducible quinic acid catabolic pathway. Three of the loci are the structural genes for the individual qa enzymes: qa-2, catabolic dehydroquinase; qa-3, quinate dehydrogenase; and qa-4, dehydroshikimate dehydrase. The fourth gene, qa-1, encodes a regulatory protein which in conjunction with the inducer quinic acid controls the expression of the three structural genes. The catabolic dehydroquinase enzyme of N. crassa has been well characterized and is capable of complementing aromatic amino acid auxotrophs deficient in the biosynthetic dehydroquinase isozyme. This combination of structural genes under the control of a tightly linked regulatory locus and a well-defined enzymatic activity (catabolic dehydroquinase), which should complement an aroD$^-$ mutant of E. coli makes the qa gene cluster an ideal DNA sequence for cloning on a recombinant plasmid. In this communication we describe the isolation and characterization of a pBR322-N. crassa recombinant plasmid that complements an aroD6 (5-dehydroquinate hydrolyase—deficient) strain of E. coli. The transformed strains contain a 5-dehydroquinate hydrolyase activity which has been shown to be biochemically and immunologically identical to N. crassa catabolic dehydroquinase. Additional characteristics of the recombinant plasmids are also described.

6717 (BNL—50674, pp 309-331) **Regulation of messenger RNA translation.** Lodish, H.F.; Bergmann, J.E.; Alton, T.H. (Massachusetts Inst. of Tech., Cambridge). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

We review current concepts and recent experiments on the structure and function of mRNA and on control of protein synthesis. Our recent work on differentiation of the slime mole Dictyostelium discoideum has elucidated a particularly clear example of control at this level, which is discussed in some detail. Control is exerted primarily at the level of polypeptide chain initiation, not elongation or termination. Cells regulate the overall rate of polypeptide chain initiation, and this regulation affects the translation of all mRNAs. The same ribosomes, initiation factors, and elongation and termination factors are apparently required and are utilized for translation of all mRNAs in a cell. Different mRNAs have different affinities for ribosome subunits or other factors involved in the initiation process; thus, over a period of time, certain mRNAs (those with higher rate constants for chain initiation) will direct the synthesis of more molecules of protein than will those with lower initiation constants. Changes in a cell of the concentration or activity of a component required for polypeptide chain initiation or elongation will not necessarily affect translation of all mRNAs to the same extent.

6718 (BNL—50674, pp 332-344) **Spliced sequence at the 5'-terminus of adenovirus late mRNA.** Berget, S.M.; Sharp, P.A. (Massachusetts Inst. of Tech., Cambridge). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Many gene products have been roughly mapped on the genome by selection of mRNAs by hybridization to specific fragments and then in vitro translation of the complementary RNA. The region of the genome coding for the major structural capsid protein, hexon, was thus placed to the right of center of the viral DNA, and the nonvirion abundant late 100K polypeptide was positioned a few thousand base-pairs further to the right of the DNA sequences coding for the hexon protein. Both these viral polypeptides are synthesized in prodigious quantities during the late part of the lytic cycle, and their corresponding mRNAs are very abundant in the cytoplasm. In order to study the mechanism of selection and processing of viral mRNAs from the nucleus, we chose to purify and biochemically define several late mRNAs. During this work, we found evidence that viral mRNA, coding for the hexon polypeptide, was complementary to more than one region of the genome. Visualization of RNA-DNA hybrids of hexon mRNA and Ad2 DNA with the electron microscope has shown that a 160-base-pair sequence at the 5'-end of this mRNA is not homologous to sequences adjacent to the main body of the hexon mRNA but is instead complementary to three transcriptionally upstream regions of the genome.

6719 (BNL—50674, pp 345-347) **Structure of late adenovirus type 2 messenger RNAs.** Gelinas, R.E.; Chow, L.T.; Roberts, R.J.; Broker, T.R.; Klessig, D.F. (Cold Spring Harbor Lab., NY). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

The possibility of mRNAs having sequences derived from more than one site on the genome was tested by forming RNA displacement loops (R-loops) between late polysomal mRNA and Ad2 DNA. In a series of experiments, the separated single strands of restriction fragments which included all or part of the viral DNA from map position 11.3 to 31.5 were annealed to Ad2DNA : RNA R-loop structures. Complex secondary hybrids formed between the 5'-ends of RNA molecules in R-loops and the single-stranded DNA restriction fragments. For 9 different late mRNAs transcribed from the R-strand and located to the right of position 36, the 5'-termini showed secondary hybridization to three short segments of the viral DNA at map positions 16.6, 19.6, and 26.6, in that order. Occasionally, the 5'-terminus of RNA in R-loops located to the right of coordinate 30 hybridized with the same viral DNA molecule near map position 20 or 27 (which had the effect of constraining the intervening DNA sequences into a loop). In addition, following hybridization of late Ad2 mRNA to a short DNA restriction fragment containing map position 16.6, the undecanucleotide, previously detected as the 5'-terminus of late mRNAs, was no longer sensitive to ribonuclease. These results demonstrate that the mRNAs are fully encoded by Ad2, but they are mosaic molecules having sequences derived from a total of four places on the viral DNA. These observations demand that new mechanisms be considered for the biosynthesis of adenovirus-2 mRNAs.

6720 (ORO—4024-6) **Effect of radiation-sensitive mutations and mutagens/carcinogens on bacterial recombination and mutagenesis.** Matney, T.S. (Texas Univ., Houston (USA). Health Science Center). 1975. Contract EY-76-S-05-4024. 8p. Dep. NTIS, PC A02/MF A01.

The genetic toxicology of gentian violet was investigated. This compound had been shown to be a potent clastogen, promoting chromatid exchanges in cell cultures. We found that while it did not promote gene mutations in the Salmonella test system, it did give a positive response in the polA$^+$/A$^-$ DNA repair deficiency test and that this activity was reduced by incubation with a liver microsomal fraction. These in vitro findings were substantiated by in vivo tests performed by Dr. Bloom at Cornell University.

6721 **Structure of nascent replicative form DNA of coliphage M13.** Dasgupta, S.; Mitra, S. (Univ. of Tennessee-Oak Ridge National Lab., TN). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 1, 153-157(Jan 1978).

Nascent replicative form type II (RFII) DNA of coliphage M13 synthesized in an Escherichia coli mutant deficient in the 5' → 3' exonuclease associated with DNA polymerase I contains ribonucleotides that are retained in the covalently closed RFI DNA sealed in vitro by the joint action of T5 phage DNA polymerase and T4 phage DNA ligase. These RFI molecules are labile to alkali and RNase H, unlike the RFI produced either in vivo or from RFII with E. coli DNA polymerase I and E. coli DNA ligase. The ribonucleotides are located at one site and predominantly in one strand of the nascent RF DNA. Furthermore, these molecules contain multiple small gaps, randomly located, and one large gap in the intracistronic region.

6722 **Modification of DNA by the benzo[a]pyrene metabolite diol-epoxide r-7,t-8-dihydroxy-t-9,10-oxy-7,8,9,10-tetrahydrobenzo[a]pyrene.** Kakefuda, T.; Yamamoto, H. (National

Institutes of Health, Bethesda, MD). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 1, 415-419(Jan 1978).

The structural modification of double-stranded circular DNA of simian virus 40 and plasmid ColE1 by in vitro binding of r-7,t-8-dihydroxy-t-9,10-oxy-7,8,9,10-tetrahydrobenzo[a]pyrene was studied. Stepwise hydrolysis with endonuclease SI and DNase followed by DNA base analysis by thin-layer chromatography provided evidence that binding to adenine caused the local denaturation of DNA, whereas the more than 10-fold greater binding to guanine did not create such local denaturation. Of the two synthetic double-stranded polymers, poly(dA-dT).poly(dA-dT) and poly(dG-dC).poly(dG-dC), bound to the diol-epoxide, only the former showed a marked hydrolysis after endonuclease S1 treatment, whereas binding occurred 24-fold more on the latter.

6723 Model of kin selection for an altruistic trait considered as a quantitative character. Yokoyama, S.; Felsenstein, J. (Univ. of Washington, Seattle). *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 1, 420-422(Jan 1978).

Conditions for natural selection to favor increase of a quantitative character are derived for a model in which individuals associate in groups of size n. It is assumed that the logarithm of the fitness of an individual is the sum of two parts, one proportional to the individual's own phenotype, and the other to the mean phenotype in its group. The resulting conditions for the trait to increase under natural selection are analogous to the results found previously in single-locus kin selection models.

6724 Leucine insertion caused by a yeast amber suppressor. Liebman, S.W. (Univ. of Rochester School of Medicine and Dentistry, NY); Stewart, J.W.; Parker, J.H.; Sherman, F. *J. Mol. Biol.;* **109**: 13-22(1977).

The amber suppressor SUP52 can cause the production of approximately 15 to 20% of the normal amount of iso-l-cytochrome c when coupled to the amber (UAG) mutant cyc1-76. The suppressed iso-l-cytochrome c contains a residue of leucine at the position corresponding to the site of the amber codon. SUP52 also supresses another amber allele cyc1-179, but only with a low efficiency of approximately 2%. It does not appear to act at all on ochre (UAA) mutants. SUP52 was found to be on the left arm of chromosome X closely linked to the centromere.

6725 Measurement of mammalian sperm deoxyribonucleic acid by flow cytometry. Problems and approaches. Van Dilla, M.A.; Gledhill, B.L.; Lake, S.; Dean, P.N.; Gray, J.W.; Kachel, V.; Barlogie, B.; Goehde, W. (Univ. of California, Livermore). *J. Histochem. Cytochem.;* **25**: No. 7, 763-773(1977).

Measurement of mammalian sperm deoxyribonucleic acid content is of importance in several areas of biomedical research. When measured in flow systems with orthogonal axes of illumination, flow and detection, an unexpected, distorted distribution consisting of a narrow peak with a lateral extension to the right is observed. Several lines of evidence lead to the conclusion that this effect is an optical-geometric artifact attributable to the flat shape and high index of refraction of mammalian sperm heads. This artifact disappears when an epi-illumination flow system is used in which the optic axes for illumination and detection and the flow axis are all coincident. Other approaches also eliminate the artifact. The resulting coefficients of variation observed after acriflavine-Feulgen staining are 4-5%, short of the goal of 1.5% required to distinguish between human sperm bearing X and Y chromosomes and to develop a mutagen test system using mice.

6726 Chromosomal evolution in a haploid frog cell line: implications for the origin of karyotypic variants. Mezger-Freed, L. (Inst. for Cancer Research, Philadelphia). *Chromosoma;* **62**: 1-15(1977).

ICR 2A, a haploid cell line derived from Rana pipiens embryos, has remained haploid in number of chromosomes and their relative lengths and centromere positions for 500 cell generations. After this time, two new haryotypes appeared; relative length measurements indicate that the first has a translocation from chromosome 4 to 6, the second translocations from 3 and 4 to 6 and 7. The single exchange karyotype is not a precursor for the double exchange according to a statistical analysis. The double exchange karyotype characterized 90% of some cultures although a selective advantage could not be demonstrated for these cells. The observations suggest that a non-clonal or multicellular origin may account for these karyotypic variants.

6727 Idiopathic acquired refractory sideroblastic anemia: banded chromosome analysis in six patients. Bitran, J.; Golomb, H.M.; Rowley, J.D. (Univ. of Chicago). *Acta Haematol.;* **57**: 15-23(1977).

Chromosome analyses with banding were performed on six patients with idiopathic acquired refractory sideroblastic anemia (IARSA). One patient was found to have an extra chromosome No. 8, but had a normal level of red cell glutathione reductase. Bone marrow chromosomes from the other patients showed a normal karyotype. 28 patients with IARSA, including our 6 patients, have had chromosomal analyses. Two consistent chromosomal abnormalities have been described: a +8 in three patients and a 20q- in three others. Despite the presence of chromosomal abnormalities in about one half of the patients, no patient has yet developed acute myelogenous leukemia. Several have died of hemochromatosis. The presence of a chromosomal abnormality appears to have no influence on the early course of IARSA.

METABOLISM

REFER ALSO TO CITATION(S) 6655, 6722, 6751, 6787, 6798

6728 Prevention of involutional bone loss by exercise. Aloia, J.F.; Cohn, S.H.; Ostuni, J.A.; Cane, R.; Ellis, K. (Nassau County Mecical Center, East Meadow, NY). *Ann. Intern. Med.;* **89**: No. 3, 356-358(Sep 1978).

To ascertain whether exercise could prevent involutional bone loss, we studied 18 postmenopausal women, half of whom exercised for 1 h three times a week. Total and regional bone mass were measured before and after 1 year of exercise by the techniques of total-body neutron activation analysis (total body calcium) and photon absorptiometry (bone mineral content) of the distal radius. Total body potassium was measured by whole body counting. Bone mineral content and total body potassium did not change significantly in either group. Total body calcium increased in the exercise group from 781 +- 95 g to 801 +- 118 g (SD). In contrast, total body calcium decreased in each subject in the sedentary group. The daily calcium balance derived from the difference in total body calcium measurements was significantly different in the two groups of women ($P < 0.001$). These data support the hypothesis that exercise can modify involutional bone loss.

6729 Distribution of calcium in the rat due to chronic renal failure. Ellis, K.J.; Martino, A.; Yasumura, S.; Brook, D.; Cohn, S.H.; Letteri, J.M. (Brookhaven National Lab., Upton, NY). *Nephron;* **18**: 124-131(1977).

During the 12 weeks following 5/6 nephrectomy in rats with moderate uremia (creatinine 0.7-1.2 mg/100 ml, BUN 53-89 mg/100 ml), no significant increases in total soft tissue calcification were observed. The calcium concentration of skeletal muscle remained unchanged at 4, 8, and 12 weeks after surgery. A slight but not significant increase in skin calcium was found. However, a significant decrease in cardiac calcium was found for the uremic animals. Total body calcium as determined by neutron activation analysis was significantly lower in the uremic rat when compared with the age-matched animal. However, when normalized for body weight, the total calcium content in uremic rats did not differ from the controls. Similar findings were observed for the absolute calcium content of the tibia and when normalized for weight. Furthermore, a highly significant linear relationship ($r = 0.92$, $p << 0.001$) was established between absolute levels of total body calcium and tibia calcium which was identical for the control and uremic groups.

6730 Quantitative measurement of demethylation of ^{14}C-methoxyl labeled DMPEA and TMA-2 in rats. Sargent, T. III; Shulgin, A.T.; Kusubov, N. (Univ. of California, Berkeley). *Psychopharmacol. Commun.;* **2**: No. 3, 199-206(1976).

Some reports have suggested that methylation and demethylation of compounds related to 6-hydroxydopamine may be involved in endogenous mental disorder. We report the synthesis of 3,4-dimethyoxyphenethylamine (DMPEA) and 2,4,5-trimethoxyphenylisopropylamine (TMA-2) with each methoxyl group separately labeled with ^{14}C. The rate and percent demethylation of these two compounds, with five labeled positions, were determined in the rat. The results suggest that TMA-2 might be metabolized to a hydroquinone in vivo; a similar metabolic intermediate of the psychoactive compound DOM is known to give rise in vitro to an indole.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 6729, 6730

6731 (BNL—24749) ^{31}P-NMR studies on perfused mouse liver. McLaughlin, A.C.; Takeda, H.; Chance, B. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 6p. (CONF-780741—2). Dep. NTIS, PC A02/MF A01.

From Frontiers of biological energetics(electrons to tissues; Philadelphia, PA, USA (19 Jul 1978).

From a metabolic viewpoint, the most important organ in the body is the liver. In contrast to more specialized organs such as heart and kidney which perform only one major function, the liver performs a number of major metabolic functions. Two of the most important functions are the catabolism and storage of foodstuffs (in

the form of glycogen) and the control of most of the constituents of the blood (in particular, the blood glucose level). Most of these functions are localized within a single type of cell. One way that the liver is able to regulate these diverse reactions is by the control of the ATP level in the cell. Encouraged by the recent success of many groups in using ^{31}P-NMR to provide a continuous and non-destructive monitor of ATP levels in isolated cells, skeletal muscle, and perfused organs such as heart and kidney, ^{31}P-NMR was used to investigate ATP levels in perfused liver of mice.

MEDICINE

REFER ALSO TO CITATION(S) 6668, 6725, 6760, 6775, 6992

6732 Tobacco smoke inhalation exposure device for rodents. Maddox, W.L. (Oak Ridge Gaseous Diffusion Plant, TN); Dalbey, W.E.; Guerin, M.R.; Stokely, J.R.; Creasia, D.A.; Kendrick, J. *Arch. Environ. Health;* **33**: No. 2, 64-71(1978).

A system which utilizes a piston pump to generate cigarette smoke under standard conditions and expose rodents to the inhalation of diluted smoke for controlled periods of time is described. Variations of the basic system have been employed to expose groups of ten to twenty hamsters or rats and should allow exposures of up to forty mice. The system has been in use for approximately 24 months in routine chronic exposures of rats. Data are presented to define the operating characteristics and typical dosimetry. Animal containment peculiar to this apparatus is described.

6733 In vitro responsiveness of lymphocytes to phytohemmagglutinin. Peterson, M.L.; Rommo, N.; House, D.; Harder, S. (Environmental Protection Agency, Chapel Hill, NC). *Arch. Environ. Health;* **33**: No. 2, 59-63(1978).

Peripheral blood lymphocytes from 20 human subjects exposed to 784 $\mu g/m^3$ ozone for 4 hours, and from 11 subjects exposed to clean air for the same length of time were studied for in vitro responsiveness to phytohemagglutinin (PHA). Thymus-derived (T) lymphocyte response to PHA (normal response is proliferation of lymphocytes) was significantly suppressed ($P < .01$) in samples obtained immediately after subjects' exposure to ozone. Recovery of response occurred 2 weeks postexposure. Responses were unchanged in subjects exposed to clean air. Existing studies suggest that ozone exposure may generate free radicals or other reactive molecules or both that could be responsible for immediate changes in metabolic events leading to blockage or inhibition of deoxyribonucleic acid (DNA) synthesis in T lymphocytes as shown in this study. It is possible that some prerequisite to active cell metabolism such as ribonucleic acid (RNA) may be impaired by ozone exposure. The significance of the suppression of T-cell response noted in this study is that: (1) if continuous exposures to ozone are shown to induce an immunosuppressed state for a significant time period, an important factor in carcinogenesis might be elucidated; (2) immunosuppression may cause a progression of an already present tumor; (3) immunosuppression may enable endogenous latent infection such as tuberculosis to reactivate; and (4) immunosuppression may explain in part the relationship between chronic oxidant air pollution and influenza-like illnesses in population.

6734 Radiographic features of pleural effusions in pulmonary embolism. Bynum, L.J.; Wilson, J.E. (Univ. of Texas, Dallas). *Am. Rev. Respir. Dis.;* **117**: No. 5, 829-834(1978).

A prospective analysis of 155 patients with pulmonary embolism was undertaken to describe the radiographic characteristics of associated pleural effusions and related abnormalities. Approximately one half of these patients had pleural effusions. Patients with other potential causes of effusion, such as heart failure, pneumonia, or cancer, were eliminated from further analysis. In the remaining 62 patients, radiographic evidence of pulmonary infarction accompanied pleural effusions in one half of the cases. One third of patients with parenchymal consolidation had no evidence of effusion. Atelectasis and other nonspecific radiographic abnormalities occurred in less than one fifth of the cases. Typically, pleural effusions were small and unilateral, appeared soon after symptoms of thromboembolism began, and tended to reach their maximal size very early in the course of the disorder. Pulmonary infarction was associated with larger effusions that cleared more slowly and were more often bloody in appearance on thoracentesis. Chest pain occurred in all but one patient and was a valuable diagnostic clue. Pain and pleural effusions were always ipsilateral and almost always unilateral, but neither correlated well with the presence or time course of infarction. Effusions that were delayed in onset or that enlarged late in the course were associated with recurrent pulmonary embolism or superinfection. These radiographic features may be helpful in the diagnosis and management of pulmonary embolism.

6735 Normal and abnormal patterns of cerebrovascular reserve tested by 133 Xe inhalation. Meyer, J.S.; Sakai, F.; Naritomi, H.; Grant, P. (Baylor Center for Cerebrovascular Research, Houston). *Arch. Neurol.;* **35**: No. 6, 350-359(1978).

Cerebrovascular functional reserve was tested by noninvasive measurement of regional cerebral blood flow (nrCBF) at rest in quiet darkness and when repeated during standard multiple psychophysiologic activation. The test was applied to normal volunteers and patients with different neurologic disorders. The test included counting, conversation, music, and observing movements, while rCBF was measured over both cerebral hemispheres, brain stem, and cerebellum. In normal persons at rest, mean gray matter flow (Fg) values were the same for each hemisphere. Highest Fg values were observed in brain stem and both frontal regions. During activation in normal persons, there was a significant increase in Fg values over both hemispheres and in brain stem. During activation, three types of abnormal rCBF responses were seen: Demented patients showed no change, patients with vascular occlusion showed little or no increase over the ischemic hemisphere, and some patients with epilepsy showed excessive increases.

6736 Patient restraining device for the pinhole collimator and gamma scintillation camera. Kay, T.D. US Patent 4,010,373. 1 Mar 1977. Filed date 10 Oct 1975. 6p.

A patient restraining device for use with the pinhole collimator of a conventional Gamma Scintillation Camera, the restraining device being made of an adapter ring and a patient holder. The adapter ring is secured directly to the pinhole collimator while the holder is adjustably mounted on the adapter. The adapter ring is so designed to accommodate a variety of holders so as to enable the scanning of many different areas of a patient's anatomy by the scintillation camera.

6737 Chromomycin A_3 as a fluorescent probe for flow cytometry of human gynecologic samples. Jenson, R.H. (Univ. of California, Livermore). *J. Histochem. Cytochem.;* **25**: No. 7, 573-579(1977).

Chemical, physical and optical properties of chromomycin A_3 are examined so as to ascertain appropriate staining and analysis procedures for flow cytometry of human gynecologic samples. Fluorescence excitation and emission spectra of chromomycin A_3-stained cervical cells are compared with those of chromomycin A_3-stained deoxyribonucleic acid. Conditions for deoxyribonucleic acid-specific staining of cervical cells are presented, and staining specificity of cervical cells with chromomycin A_3 is compared to that obtained with ethidium bromide, propidium iodide and Hoechst 33258. Also presented is a brief review of two parameter flow cytometry as a prescreening procedure for detection of cervical neoplasia. Results of flow cytometry and cell sorting are interpreted based on the deoxyribonucleic acid-specificity of chromomycin A_3 staining.

6738 Apparatus and method for locating and quantifying or directing a source of ionizing radiation. Rogers, W.L.; Wainstock, M.A. (to Univ. of Michigan). US Patent 3,997,793. 14 Dec 1976. Filed date 7 Nov 1975. 14p.

An apparatus and method for locating or directing a source of ionizing radiation such as X-rays, gamma rays, alpha particles, beta particles, etc. are described. The preferred embodiment detects and locates abnormalities of the body such as ocular melanomas by detecting the emission of radiation from a melanoma which has absorbed a radioactive medium. The apparatus includes an ultrasound probe which emits ultrasonic waves along a first axis and detects a returned portion of the waves. The ultrasound probe is associated with a display which displays the returned portion of the waves in the time domain so that suspected abnormalities can be located. The ultrasound probe is used to guide a directional probe for detecting and quantifying ionizing radiation which is equipped with a focusing collimator having a focal point along a second axis. The two probes are supported so that the first and second axes converge at the focal point of the collimator. A range marker is associated with the ultrasonic detector which indicates the point of convergence of the axes on the ultrasonic display permitting guidance of the radiation detecting probe to the suspected abnormality.

6739 Radioassay of folates. Givas, J.K.; Gutcho, S. (to Becton, Dickinson and Co.). US Patent 3,988,431. 26 Oct 1976. Filed date 12 Dec 1974. 6p.

In the radioassay of folates, the standard is prepared by using folic acid (pteroyl glutamic acid; PGA) as the standard folate at a pH of 9.2 to 9.4. At such pH values, folic acid and 5-methyltetrahydrofolic acid (the predominant folate in human serum) have essentially identical reactivity towards folate binders, whereby folic acid can replace unstable 5-methyltetrahydrofolic acid standard for such assays.

6740 Apparatus for examining a body by radiation such as x gamma radiation. Hounsfield, G.N. (to E M I Ltd.). US Patent 3,944,833. 16 Mar 1976. Priority date 23 Aug 1968, United Kingdom of Great Britain and Northern Ireland (UK). 14p.

Apparatus for examining a body by means of radiation such as X or γ radiation includes a source of a substantially planar, sectoral-shaped swath of said radiation, collimator means having a plurality of apertures formed therein through which respective finger-like beams of the radiation can pass. The beams follow respective linear paths through a region of interest and toward detector means located on the opposite side of said region to the source; the detector means including a respective detector device for each of said finger-like beams. Conveniently each device constitutes a scintillator device and an associated photomultiplier tube, and the tubes associated with adjacent scintillator devices are misaligned to accommodate their widths. Means are also provided for orbiting the apparatus relative to said region of interest.

6741 Method of and an apparatus for examining a sample or a material by measuring the absorption of γ- or x-ray radiation. Dissing, E. (to Aktiebolaget Atomenergi). US Patent 3,944,830. 16 Mar 1976. Priority date 11 May 1973, Sweden. 8p.

A method of and an apparatus for human bone density determination in vivo. γ- or x-ray radiation of two different photon energies is scanned across the human body part to be examined. For the two photon energies, the logarithms of the intensities of the radiation transmitted through the human body part are determined simultaneously. The logarithm values obtained are processed on line such that the ratio of these values is changed by a predetermined factor. The processed values are subtracted from each other to produce a simultaneous output value which is integrated to give an examination result proportional to the bone tissue content expressed as weight per length unit in a direction perpendicular to the scanning direction while being independent of the surrounding soft tissue.

6742 Apparatus for examining objects by means of penetrating radiation. Hounsfield, G.N. (to E M I Ltd.). US Patent 3,940,625. 24 Feb 1976. Priority date 1 Jun 1973, United Kingdom of Great Britain and Northern Ireland (UK). 6p.

Apparatus for examining a human patient by means of penetrating radiation has a source of radiation for producing a sectoral swath of radiation which traverses a planar slice of the patient and is then measured by a bank of detectors each of which is sensitive to a narrow beam of the radiation in said swath. The swath of radiation is produced by a rotating anode Coolidge tube and means are provided for monitoring the radiation intensity at spaced positions across the width of the swath and for taking account of variations of the intensity in the output signals derived from the detectors. Preferably radiation emitted from the anode at near tangential directions is selected to form the swath.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 5152, 6734, 6735, 6736, 6738, 6739, 6740, 6741, 6742, 6761, 6775

6743 Changes in license conditions for certain medical therapy licensees. *Fed. Regist. (Wash., D.C.);* **43**: No. 125, 27995(28 Jun 1978).

From Energy, 10CFR35, Nuclear Regulatory Commission. Human uses of byproduct material.

Certain NRC licensees are authorized to treat patients with implants incorporating radioactive material. NRC is considering requiring such licensees to confirm the removal of the implants at the end of the treatment by (1) a source count and (2) a radiation survey of the patient. Failure to account for all implants at the conclusion of patient treatment has resulted in some instances of unnecessary radiation exposure to patients and members of the general public.

6744 Ga-67 citrate imaging in tumors of the genito-urinary tract: report of cooperative study. Sauerbrunn, B.J.; Andrews, G.A.; Huebner, K.F. (Veterans Administration Hospital, Washington, D.C.). *J. Nucl. Med.;* **19**: No. 5, 470-475(May 1978).

Whole-body imaging with Ga-67 citrate in 127 tumors of the genito-urinary tract has been evaluated by a cooperative group using a uniform protocol. Primary sites of tumor were not detectable by imaging, except for one bladder and one kidney tumor. Proven and apparent metastases yielded positive scans, however, in 51% of prostatic, 50% of bladder, 72% of kidney, and 53% of testicular neoplasms. In bladder and kidneys metastases, if bone sites are excluded, detection of soft tissue metastases was 61% and 75%, respectively. In embryonal-cell carcinoma of the testicle, 74% of metastatic foci were detected.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 5423, 6651, 6707, 6801, 6802

6745 Application of mass and energy balance regularities in fermentation. Erickson, L.E.; Minkevich, I.G.; Eroshin, V.K. (Inst. of Biochemistry and Physiology of Microorganisms, Moscow). *Biotechnol. Bioeng.;* **20**: No. 10, 1595-1621(Oct 1978).

Material and energy balances for fermentation processes are developed based on the facts that the heat of reaction per electron transferred to oxygen for a wide variety of organic molecules, the number of available electrons per carbon atom in biomass, and the weight fraction carbon in biomass are relatively constant. Mass-energy balance equations are developed which relate the biomass energetic yield coefficient to sets of variables which may be determined experimentally. Organic substrate consumption, biomass production, oxygen consumption, carbon dioxide production, heat evolution, and nitrogen consumption are considered as measured variables. Application of the balances using direct and indirect methods of yield coefficient estimation is illustrated using experimental results from the literature. Product formation is included in the balance equations and the effect of product formation on biomass yield estimates is examined. Application of mass-energy balances in the optimal operation of continuous single-cell protein production facilities is examined, and the variation of optimal operating conditions with changes in yield are illustrated for methanol as organic substrate.

6746 Application of mass and energy balance regularities to product formation. Erickson, L.E. (Kansas State Univ., Manhattan); Selga, S.E.; Viesturs, U.E. *Biotechnol. Bioeng.;* **20**: No. 10, 1623-1638(Oct 1978).

Material and energy balances for fermentation processes with product formation are developed using regularities which are frequently useful in analyzing experimental results. Available electron balances are presented and used to analyze the results of experiments in which biomass and lysine are produced in batch culture using molasses and corn extract as organic substrates. Measured values of biomass productivity, lysine productivity, O_2 consumption rate, heat evolution rate, CO_2 evolution rate, and rate of utilization of reducing sugars (RS) are used to obtain estimates of biomass energetic yield, lysine energetic yield, and fraction of substrate energy evolved as heat. For two of the three experiments, based on the entire fermentation, the measured mass rate variables are very consistent and energy measurement errors are less than 10% when proper consideration is given to both the RS and the amino acids present in the organic substrate. The average measured value of 26.5 kcal/equivalent (equiv) of available electrons transferred to oxygen compares favorably with the known average value of 27 kcal/equiv.

6747 Production of microbial protein from tree bark by Phanerochaete chrysorporium. Daugulis, A.J.; Bone, D.H. (Queen's Univ., Kingston, Ontario). *Biotechnol. Bioeng.;* **20**: No. 10, 1639-1649(Oct 1978).

Phanerochaete chrysosporium was grown in fermentors on NaOH-extracted maple, pine, and cedar barks at the optimum substrate concentration of 1% (w/v). The yields (mg protein/liter) on maple, pine, and cedar were 1500, 1200, and 880, respectively, which are probably due to the different lignin contents of the barks. Lignin is not utilized. The productivities at 30°C obtained for pine (4.07×10^{-2} g protein/liter hr) and cedar (2.63×10^{-2} g protein/liter hr) barks were greater than for maple (2.63×10^{-2} g protein/liter hr). The substrate (bark) was the limiting component of the fermentation. Over the 26 to 38°C temperature range protein productivity increased by a factor of three (1.55×10^{-2} vs. 4.61×10^{-2} g protein/liter hr) for maple bark. Low agitation rates resulted in an overproduction of cellulase and reduced levels of microbial protein.

6748 Timing of some of the molecular events required for cell fusion induced by herpes simplex virus type 1. Kousoulas, K.G.; Person, S.; Holland, T.C. (Pennsylvania State Univ., University Park). *J. Virol.;* **27**: No. 3, 505-512(Sep 1978).

The timing of some of the molecular events that are required for cell fusion was investigated. Cell fusion was produced by a mutant of herpes simplex virus type 1 that causes extensive cell fusion during infection. The timing of molecular events required for fusion was established by the use of blocking agents. Phosphonoacetic acid blocks viral DNA synthesis; actinomycin D blocks RNA synthesis; cycloheximide blocks protein synthesis; 2-deoxyglucose blocks glycosylation of glycoproteins; high temperature, NH_4Cl, and adamantanone block unknown steps required for cell fusion. For cells infected at a low multiplicity of infection, phosphonoacetic acid decreased the rate but not the final amount of fusion, but at a multiplicity of infection of 10 it had no effect on the rate of cell fusion. RNA synthesis was required for fusion until 4 h after infection, protein synthesis until 5.5 h after infection, and glycosylation until 7 h after infection. The temperature-dependent step occurred before 6 h after infection, whereas NH_4Cl and adamantanone acted at steps that occurred until 8 h after infection. Cycloheximide, temperature, NH_4Cl, and adamantanone acted reversibly; actinomycin D and 2-deoxyglucose acted irreversibly. The same order of action of the inhibitors was also determined by using pairs of

inhibitors sequentially. These experiments also indicated that the fusion factor was not an α-polypeptide. Virus growth and cell fusion were both found to be highly dependent on temperature in the range of 30 to 40°C. Wild-type infections are apparently characterized by the presence of a fusion factor and a fusion inhibitor. The fusion-blocking agents were added to wild-type-infected cells under a variety of conditions in an attempt to selectively block the production of the fusion inhibitor molecule and thereby cause extensive cell fusion. However, fusion was not observed in any of these experiments.

6749 Distribution of hydrocarbon-utilizing microorganisms and hydrocarbon biodegradation potentials in Alaskan continental shelf areas. Roubal, G.; Atlas, R.M. (Univ. of Louisville, KY). *Appl. Environ. Microbiol.;* **35**: No. 5, 897-905(May 1978).

Hydrocarbon-utilizing microogranisms were enumerated from Alaskan continental shelf areas by using plate counts and a new most-probable-number procedure based on mineralization of ^{14}C-labeled hydrocarbons. Hydrocarbon utilizers were ubiquitously distributed, with no significant overall concentration differences between sampling regions or between surface water and sediment samples. There were, however, significant seasonal differences in numbers of hydrocarbon utilizers. Distribution of hydrocarbon utilizers within Cook Inlet was positively correlated with occurrence of hydrocarbons in the environment. Hydrocarbon biodegradation potentials were measured by using ^{14}C-radiolabeled hydrocarbon-spiked crude oil. There was no significant correlation between numbers of hydrocarbon utilizers and hydrocarbon biodegradation potentials. The biodegradation potentials showed large seasonal variations in the Beaufort Sea, probably due to seasonal depletion of available nutrients. Non-nutrient-limited biodegradation potentials followed the order hexadecane > naphthalene >> pristane > benzanthracene. In Cook Inlet, biodegradation potentials for hexadecane and naphthalene were dependent on availability of inorganic nutrients. Biodegradation potentials for pristane and benzanthracene were restricted, probably by resistance to attack by available enzymes in the indigenous population.

6750 Isolation and characterization of naturally occurring hair-pin structures in single-stranded DNA of coliphage M13. Niyogi, S.K.; Mitra, S. (Oak Ridge National Lab., TN). *Biochem. Biophys. Res. Commun.;* **79**: No. 4, 1037-1044(1977).

With precise conditions of digestion with single-strand-specific nucleases, namely, endonuclease S1 of Aspergillus oryzae and exonuclease I of Escherichia coli, nuclease-resistant DNA cores can be obtained reproducibly from single-stranded M13 DNA. The DNA cores are composed almost exclusively of two sizes (60 and 44 nucleotides long). These have high (G + C)-contents relative to that of intact M13 DNA, and arise from restricted regions of the M13 genome. The resistance of these fragments to single-strand-specific nucleases and their nondenaturability strongly suggest the presence of double-stranded segments in these core pieces. That the core pieces are only partially double-stranded is shown by their lack of complete base complementarity and their pattern of elution from hydroxyapatite.

6751 Ability of enteric bacteria to catalyze the covalent binding of bile acids and cholesterol to DNA and their inability to metabolize benzo(A)pyrene to a binding product and to known metabolites. Zachariah, P.K.; Slaga, T.J.; Berry, D.L.; Bracken, W.M.; Buty, S.G.; Martinsen, C.M.; Juchau, M.R. (Oak Ridge National Lab., TN). *Cancer Lett. (Amsterdam);* **3**: 99-105(1977).

The capacity of enteric bacteria (E. coli, Salmonella, Pseudomonas, Shigella and Klebsiella) to catalyze the covalent binding of benzo(a)pyrene (BP), cholic acid, deoxycholic acid and cholesterol was investigated. In general, these bacteria were incapable of activating BP to a covalently bound product with calf thymus DNA. Metabolism studies of BP by fluorometric assay failed to indicate any accumulation of BP-3-hydroxy in the incubation medium. Detailed metabolic investigation with high-pressure liquid chromatography indicated that these bacteria did not produce any known metabolites which are formed by mammalian systems. However, radioactivity was detected in all fractions, suggesting that the bacteria were readily metabolizing BP into smaller molecules for energy and carbon sources. Although the enteric bacteria did not metabolize BP into known metabolites, some were capable of activating cholesterol, cholic acid and deoxycholic acid to covalently bound products with DNA. The binding data with cholesterol and bile acids also suggested that the binding process required NADPH as a cofactor because binding level was rather low without NADPH.

6752 Bacteriophage-induced inhibitor of a host enzyme. Price, A.R. pp 290-294 of Microbiology 1976. Washington, DC; American Society for Microbiology (1976).

Bacillus subtilis bacteriophage PBS2 is unique among viruses in that its DNA contains uracil instead of thymine. Our interest is to determine how and why PBS2 contains this unusual base in its DNA. New proteins induced after infection of B. subtilis by PBS2 phage include: dTMP 5'-phosphatase, which also has dUMP 5'-phosphatase activity; dCTP deaminase; dUMP kinase; DNA polymerase; RNA polymerase; an inhibitor of the host's DNase specific for uracil-containing DNA; and an inhibitor of the host's N-glycosidase specific for uracil-containing DNA. This paper describes the discovery of another PBS2 protein: a phage-induced inhibitor of the B. subtilis dUTPase. The cellular dUTPase is thought to help exclude uracil from B. subtilis DNA, by hydrolyzing dUTP to dUMP plus inorganic pyrophosphate. We believe that an important function for PBS2 phage is to inhibit the host's dUTPase, thereby allowing dUTP to accumulate for the synthesis of PBS2 uracil-containing DNA.

6753 Role of protein in the inactivation of viruses by ultraviolet radiation. Gordon, M.P. (Univ. of Washington, Seattle). pp 105-122 of Aging, carcinogenesis, and radiation biology. Smith, K.C. (ed.). New York; Plenum Publishing Corp. (1975).

The capsomers of viruses contain proteins, lipids, and carbohydrates. The components of the capsomer frequently participate in the initial stages of the infectious process and in some instances, furnish enzymatic activity vitally needed for viral replication. The capsomers also serve to protect the viral nucleic acid from inactivation by a variety of enzymatic and physical agencies such as actinic radiation. The purpose of this paper is to review the current knowledge of the action of light on viruses. The three areas which will be considered are: (1) the introduction of protein-nucleic acid cross-links in viruses by light, (2) the modification of the types of photochemical lesions introduced into nucleic acids by the presence of capsomer proteins, and (3) the protection and sensitization of viral nucleic acids by proteins.

MORPHOLOGY

6754 Oogenesis in xenopus laevis (Daudin). V. Relationships between developing oocytes and their investing follicular tissues. Dumont, J.N.; Brummett, A.R. (Oak Ridge National Lab., TN). *J. Morphol.;* **155**: No. 1, 73-97(Jan 1978).

The relationship of the cells and tissues which comprise the developing ovarian follicle in Xenopus laevis has been studied with scanning and transmission electron microscopy. The saclike ovary is covered on its coelomic side by a squamous epithelium. The cells of this epithelium are extensively interdigitated, and each bears a short, centrally positioned cilium. The lumenal surface of the ovary is covered with a layer of nonciliated squamous cells. The areas of cell-cell contact are characterized by desmosomes in both epithelia, and between the epithelia lies a connective tissue layer--the theca--which contains collagen fibers, blood vessels, nerves, smooth muscle cells and oogonia. Beneath the theca in each follicle lies a single layer of flat stellate follicle cells. Associations between adjacent follicle cells are intermittent, leaving wide spaces or channels. Junctional contacts between neighboring follicle cells are characterized by desmosomes. From the basal surface of each follicle cell extend long, broad macrovilli which penetrate the underlying acellular vitelline envelope and contact the surface of the oocyte. Evidence is presented which suggests that follicle cells may produce and release components which participate in the formation of the vitelline envelope which consists of a 3-dimensional lattice of ropey fibers. Passageways through the vitelline envelope allow the maintenance of contact between oocyte and follicle cells and also allow ready penetration of materials both to the oocyte (e.g., vitellogenin) and from it (e.g., cortical granule material) at different stages of its development.

6755 Sex differences in Necturus urinary bladders. LeFevre, M.E. (Brookhaven National Lab., Upton, NY); Norris, J.; Hammer, R. *Anat. Rec.;* **187**: No. 1, 47-62(Jan 1977).

We describe morphological sex differences in urinary bladders of the urodele amphibian Necturus maculosus. The mucosal epithelial cells of bladders from males were tall and contained considerable PAS-positive material. In scanning electron micrographs of the mucosal surface, epithelial cells from male bladders were well demarcated and were capped with microplicae or with long cilia. The mucosal epithelial cells of bladders from females were low and contained only a small amount of PAS-positive material; in scanning electron micrographs cell boundaries could not be distinguished and no cilia or microplicae were present. Bladders from males had higher transepithelial potential difference and lower water content than bladders from females. Urine analyses were not significantly different in the two sexes. It is suggested that response to androgens in the male accounts for the observed differences.

6756 Interruption of proecdysis by autotomy of partially regenerated limbs in the land crab, Gecarcinus lateralis. McCarthy, J.F.; Skinner, D.M. (Oak Ridge National Lab., TN). *Dev. Biol.;* **61**: 299-310(1977).

In the land crab, Gecarcinus lateralis, autotomy of partially regenerated limbs before a critical stage in the premolt period results

in (1) a very rapid decrease in the serum ecdysone titer, (2) a delay in the growth of partial regenerates remaining on the animal, (3) a delay in the deposition of gastroliths, and (4) a delay in cytological changes in the epidermis. Serum ecdysone titers remain low while new limb regenerates form at the sites of those removed. Ecdysone titers rise when these secondary regenerated complete basal regeneration. Premolt events, which had ceased at the time of autotomy of the partial regenerates, resume their normal patterns of development when ecdysone titers reach the level present in the serum at the time of this interruption. We propose that the effect of autotomy before a critical period is to reinitiate a normal proecdysis. The same pattern of events occurs following autotomy of partial regenerates of crabs without eyestalks, suggesting that the decrease of serum ecdysones is brought about by some mechanism other than changes in the titer of the molt inhibitory hormone.

6757 Studies on Tintinnida using scanning electron microscopy. Gold, K.; Morales, E.A. (Osborn Labs. of Marine Sciences, Brooklyn). *Trans. Am. Microsc. Soc.;* **95**: No. 4, 707-711(1976).

Two species of Tintinnida were grown in vitro and their loricae examined by SEM. Tintinnopsis parva loricae clearly showed the anterior spiral region characteristic of a number of species in this genus. A novel method of building a lorica, one using fibrous spherules, was found for Tintinnidium sp. The authors confirm earlier analyses of the structure of the adoral membranelles and add to the knowledge of the arrangement of the somatic cilia.

PATHOLOGY

REFER ALSO TO CITATION(S) 6655, 6680, 6688, 6690, 6696, 6728, 6751, 6802

6758 (BNL—50674, pp 50-61) **Viroids: autoinducing regulatory RNAs.** Diener, T.O. (Plant Protection Inst., Beltsville, MD). Mar 1978.

From 29. Brookhaven symposia in biology; Upton, NY, USA (17 May 1977).

In Genetic interaction and gene transfer.

Properties of purified viroids are discussed with regard to molecular structure, physical, and chemical properties. Thermal denaturation, base composition, end-group analysis, and in vitro translation are described. Viroid-host cell interactions are discussed with regard to possible mechanisms of replication, mechanisms of pathogenesis, and possible origin of viroids. A speculative model of viroid replication and pathogenesis is presented. (HLW)

6759 Hodgkin's disease: problems of staging. Sweet, D.L. Jr.; Kinnealey, A.; Ultmann, J.E. (Univ. of Chicago). *Cancer, Suppl.;* **42**: No. 2, 957-970(Aug 1978).

The preferred histopathological classification of Hodgkin's disease (HD) is suggested by Lukes and Butler as modified at the Rye Symposium; the histologic subtypes are highly reproducible and correlate well with the anatomic sites of involvement, clinical stage, and survival. The accuracy of the bipedal lymphangiogram, ^{67}gallium scan, and ultrasonography in predicting abdominal involvement by HD is 90 percent, 50 percent, and 88 percent, respectively. Staging laparotomy remains the most accurate method of detecting intra-abdominal disease and has added immensely to new concepts in the management of HD. These concepts suggest that patients with nodal disease limited to the celiac axis or upper para-aortic areas (substage III_1) or pathologic stage (PS) III/sub S+N-/A, when treated with extended field radiotherapy alone have survival rates comparable to PS IIA patients. In contrast, patients in PS IIIA with lower abdominal nodal disease (substage III_2), regardless of splenic involvement, have a prognosis comparable to PS IV disease. Thus, there may only be two stages of HD, those curable with extended mantle or smaller radiotherapy fields alone, and those requiring chemotherapy with or without supplemental radiotherapy.

6760 Increase in immunogenicity of a pulmonary squamous-cell carcinoma, propagated in vitro. Jamasbi, R.J.; Nettesheim, P. (Oak Ridge National Lab., TN). *Int. J. Cancer;* **20**: 817-823(1977).

The chemically induced, non-immunogenic lung squamous-cell carcinoma (MSC-10) propagated in vitro gradually loses tumorigenicity in immunocompetent hosts with increasing in vitro passage. This was found to be related to an increase in antigenicity, since immunosuppressed hosts (thymectomy plus 600 rads whole body X-irradiation) supported the growth of tumor cells, whereas immunocompetent recipients did not. The antigens involved in rejection are not heterologous serum proteins present in culture media since the cell line grown in isologous serum is also rejected. Immunization with the in vitro tumor line partially protected against the parental in vivo line, therefore the antigens involved must be present on both tumor lines. Inoculation of the cultured cell line into normal or immunosuppressed hosts produced tumors with the same histological characteristics as those of the in vivo tumor line. We concluded that by in vitro culture the weakly antigenic carcinoma becomes more immunogenic and thereby capable of inducing transplantation resistance. The cultured tumor cells retain their antigenic specificity and histologic characteristics while increasing their antigenic potency.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 6654, 6660, 6664

6761 (UR—3490/LCP-12) **Affinity of antibody secreted by a single cell.** Doran, D.M. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1978. Contract EY-76-C-02-3490. 131p. Dep. NTIS, PC A07/MF A01.

Thesis.

It was the intention of this research to measure the affinity of antibody secreted by a single cell, and to describe the spectrum of affinities displayed in response to antigenic stimulation. The single cell secreting specific antibody was isolated by means of the hemolytic plaque assay. The amount of antibody secreted by the cell was to be measured through the use of a solid phase radioimmunoassay. The affinity of the antibody would be estimated by comparing the diameter of the plaque, and the amount of antibody secreted, with a mathematical theory of the formation of a plaque in agar. As a test system, a solid phase radioimmunoassay was developed for human serum albumin using antibody coupled to Sephadex. A sensitivity of 1 nanogram was attained with this assay. A solid phase radioimmunoassay for mouse immunoglobulin M was developed, using antibody coupled to Sepharose. The sensitivity attained with this assay was only on the order of 10 micrograms. The mouse immunoglobulin M radioimmunoassay was not sensitive enough to measure the amount of antibody secreted by a single cell. From a theoretical equation, the relationship between antibody affinity, plaque diameter and antibody secretion rate was calculated for the experimental conditions used in this research. By assuming a constant antibody secretion rate, an effective binding constant for the antibody was estimated from the average plaque diameters. This effective binding constant was observed to increase during the immune response.

6762 Loss of proliferative capacity in immunohemopoietic stem cells caused by serial transplantation rather than aging. Harrison, D.E.; Astle, C.M.; Delaittre, J.A. (Jackson Lab., Bar Harbor, ME). *J. Exp. Med.;* **147**: No. 5, 1526-1531(1978).

Marrow stem cell lines from old donors and those from young controls gave equally rapid rates of colony growth on spleens of irradiated mice. Old and young stem cell lines competed equally well with chromosomally marked marrow stem cells from a young donor in producing cell types that are stimulated by bleeding; old cells competed 70 percent as well as young in producing cell types stimulated by phytohemagglutinin (PHA) in vitro. After a single serial transplantation, the rates of colony growth declined 1.5 to 2.5-fold, and the ability to compete declined 2- to 4-fold for bleeding-stimulated and 4- to 10-fold for PHA-stimulated cells. Thus, immediate stem cell proliferative capacities decline much more after one serial transplantation than after a lifetime of normal function.

6763 Digital image processing for medical diagnoses using gamma radionuclides and heavy ions from cyclotrons. Budinger, T.F. (Univ. of California, Berkeley). pp 161-185 of Digital processing of biomedical images. Preston, K. Jr.; Onoe, M. (eds.). New York; Plenum Publishing Corp. (1976).

Two-dimensional image enhancement and restoration procedures as well as transverse section reconstruction from multiple views are methods of digital image processing with some useful applications to nuclear medicine. Simple spatial filtering has only limited application to nuclear medicine because the impulse response changes significantly with organ distance from the detectors; however other methods of image processing have been found to benefit clinical diagnoses. These techniques include thresholding ahd contrast enhancement, dual isotope image subtraction, synthesis of parametric images, stop-action imaging techniques, motion image, digital tomography, coded aperture tomography, and transverse section image reconstruction. The last section of this paper presents a new approach to three-dimensional reconstruction using transmitted heavy ions from cyclotrons.

6764 Effects of altered autonomic control on left ventricular function in conscious dogs. Bishop, V.S.; Horwitz, L.D. (Univ. of Texas Medical School, San Antonio). *Arch. Sci. Physiol.;* **221**: No. 5, 1278-1282(Nov 1971).

In eight conscious dogs, effects of beta-adrenergic, vagal, and combined beta-adrenergic and vagal blockage on left ventricular internal diameter, pressure, and outflow were measured at rest and during acute volume loading. At rest, beta-adrenergic blockage resulted in a decrease in heart rate with no change in stroke volume but increased end-diastolic and end-systolic diameters, whereas vagal blockage resulted in an elevated heart rate with reductions in stroke

volume, end-diastolic, and end-systolic diameters. Combined blockage, at rest, was associated with elevations in heart rate, diminished stroke volume, and increases in end-diastolic and end-systolic diameters. During acute volume loading, beta-adrenergic blockage reduced peak heart rate and stroke volume, and elevated end-systolic diameter, whereas vagal blockage, despite an elevated heart rate, did not alter peak stroke volume and reduced end-diastolic diameter. The response to acute volume loading in combined blockage was characterized by reduction in peak stroke volume and end-diastolic diameter. Stroke volume was found to be dependent not only on the initial fiber length but also on the sympathetic innervation. This was demonstrated by the increase in end-systolic diameter following beta-adrenergic blockage.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 6763

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 6732, 6743, 6810, 6811, 6812

6765 Access to the log of occupational injuries and illnesses to employees and their representatives. *Fed. Regist. (Wash., D.C.);* **43**: No. 141, 31324-31329(21 Jul 1978).

From Labor, 29CFR1904, Occupational Safety and Health Administration, Department of Labor. Recording and reporting occupational injuries and illnesses.

The Secretary of Labor in cooperation with the Secretary of Health Education, and Welfare is required by the Occupational Safety and Health Act of 1970 to prescribe regulations requiring employers to maintain accurate records of, and to make periodic reports on, work related deaths, injuries and illnesses other than minor injuries requiring only first aid treatment. This document revises the requirements of the recordkeeping regulations in 29 CFR Part 1904 to provide access to form OSHA No. 200, the log and summary of occupational injuries and illnesses to employees, including employers, and their representatives. The statutory requirements for occupational safety and health standards also include the employee's basic right to know about workplace hazards. Since the log contains a record of each reported workplace injury and illness, employees will be more fully alerted to present and possible hazards in the workplace and thus would be significantly assisted in their efforts under the act to protect themselves from hazards. For example employees will be able to use the information contained in the log as a first step in tracing the nature and effects of toxic substances, as well as substances not known to be toxic, and in identifying patterns of injuries or symptoms which indicate need for further exploration. Moreover, former employees retrospectively will be able to examine log information about employees who may have been or are still involved in similar working conditions and perhaps exhibiting common symptoms. Finally, access to the log and the detailed information required to be included therein will provide a necessary and important means for employees to check the accuracy of the log entries.

6766 Lead contamination in the homes of employees of secondary lead smelters. Rice, C.; Fischbein, A.; Lilis, R.; Sarkozi, L.; Kon, S.; Selikoff, I.J. (The Mount Sinai Hospital, New York). *Environ. Res.;* **15**: No. 3, 375-380(Jun 1978).

The lead content of particulates in 33 homes of employees of two secondary lead smelters in different geographical areas of the country was investigated. Employees generally showered before going home and work clothes were laundered by the companies. Despite these hygiene measures, the lead content of particulates in the workers' homes was found to be significantly greater than in samples collected in control homes in the same or similar neighborhoods. Samples were collected by the Vostal method. In one area, a geometric mean of 79.3 μg of lead/towel was found in the workers' homes, compared with 28.8 μg/towel in the homes of workers with no history of lead exposure. In the second area studied, a geometric mean of 112.0 μg was determined in the workers' homes, compared with 9.7 μg in the homes of controls. In the latter area, paint chips, particulates from the sidewalk curb, and settled dust were also collected and analyzed for lead content. Elevated zinc protoporphyrin levels were found in some children of lead-exposed workers, but not among children in control homes.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 5500, 5503, 6041, 6064, 6103, 6509, 6587, 6588, 6645, 6646

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 6506, 6507, 6508

RADIATION EFFECTS ON BIOCHEMICALS

REFER ALSO TO CITATION(S) 6647, 6648

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 6675

RADIATION EFFECTS ON MICROORGANISMS

FOOD PRESERVATION

6767 Cryogenic gamma irradiation of prototype pork and chicken and antagonistic effect between Clostridium botulinum types A and B. Anellis, A.; Shattuck, E.; Morin, M.; Srisara, B.; Qvale, S.; Rowley, D.B.; Ross, E.W. Jr. (Army Natick Research and Development Command, MA). *Appl. Environ. Microbiol.;* **34**: No. 6, 823-831(Dec 1977).

Inoculated, irradiated pork (2,300 cans) and chicken (2,000 cans) pack studies were performed to establish the 12D dose for these foods. Each can was inoculated with a mixture of 10(6) spores of each of 10 strains of Clostridium botulinum (five type A and five type B), or a total of 10(7) spores. The cans received a series of increasing doses of gamma rays (60Co) at -30 +/- 10 degrees C; they were incubated for 6 months at 30 +/- 2 degrees C and examined for swelling, toxicity, and recoverable botulinal cells. The highest rate of swelling for both foods occurred within the first week of incubation, and maximum swelling was observed within 4 to 5 weeks. The minimal experimental sterilizing dose (ESD) based on flat, nontoxic sterile cans was 3.0 less than ESD less than or equal to 3.2 Mrad for pork and 4.0 less than ESD less than or equal to 4.2 Mrad for chicken. An analysis of the partial spoilage data by extreme-value statistics indicated with 90% confidence that the rate of spore death in the two foods was not a normal distribution, but appeared to favor a shifted exponential function. Based on the latter distribution, and assuming one most resistant strain in the mixture of 10 used, the 12D dose computed to 4.37 Mrad, with a shoulder of 0.11, for pork and 4.27 Mrad, with a shoulder of 0.51 Mrad, for chicken.

RADIATION EFFECTS ON PLANTS

6768 (NVO—181, pp 53-79) **Status of annual plant species in the Baneberry fallout pattern first and sixth years after initial irradiation.** Rhoads, W.A. (EG and G, Inc., Goleta, CA). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

At Project Baneberry on December 18, 1970, there was an accidental venting of radioactive debris into the environment which resulted in the irradiation of vegetation about 1.5 km to the north with doses estimated to reach a maximum of 6.2 K rads, beta plus gamma. At the highest doses, 35 percent of the dominant shrub in the area, Coleogyne (black brush), were killed and 65% severely damaged; and at lesser doses there was correspondingly less damage. Other species of shrubs were also affected. Grayia spinosa showed a low frequency of stem fasciation at the higher doses as well as other manifestations of radiation damage. In June 1971, the annual plant species which were probably small seedlings at fallout time were more frequently absent from the higher radiation areas than in the lower. At the same time, there was a greater frequency of higher dry weights produced by annuals at the higher radiation exposures. The frequency of occurrence of annuals varied from means of 8.5/m^2 at the higher doses to 24.3/m^2 at the lower doses. In June 1976, five years after irradiation, there were 300 to 400 plants/m^2. By extrapolating the plants/m^2 against dose back to zero plants/m^2, some indication of radiation doses which might destroy all annuals was derived.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 5359

6769 (COO—0323-40) **Preparation of conducting solid mixtures.** Spokas, J.J. (Illinois Benedictine Coll., Lisle (USA). Physical Sciences Lab.). 31 Jul 1978. Contract EY-76-S-02-0323. 84p. Dep. NTIS, PC A05/MF A01.

Portions of document are illegible.

The application of conducting plastic mixtures to the fundamental problem of radiation dosimetry is briefly reviewed. A particular approach to achieving formulations with the necessary characteristics is described. A number of successful mixtures are defined for a number of different specific dosimetry situations. To obtain high quality stable materials requires intense blending and working of the materials at elevated temperatures. One machine that succeeds in this task is the Shonka plastics mixer-extruder. The Shonka mixer is described in complete detail. The procedures used in preparing representative formulations with this device are presented. A number of properties of successful conducting mixtures so prepared are summarized. The conditions required for molding such material are given. Several special welding methods for specific application with these formulations have been devised and are described.

6770 (NUREG/CR—0215) **Estimates of potential radiation doses from wristwatches containing tritium gas.** McDowell-Boyer, L.M.; O'Donnell, F.R. (Oak Ridge National Lab., TN (USA)). 17 Feb 1978. Contract W-7405-ENG-26. 34p. (ORNL/NUREG/TM—225). Dep. NTIS, PC A03/MF A01.

Potential radiation doses were estimated for the United States population from normal distribution, use, repair, and disposal of wrist watches containing up to 200 mCi of tritium (H-3) gas in sealed glass tubes which function as self-luminous light sources. The maximum annual total-body dose was calculated to be 0.3 mrem during watch distribution. Watch wearers were estimated to receive annual total-body doses in the range 0.003 to 0.02 mrem. The total population dose from an annual distribution of one million watches was estimated to be 490 man rem, with approximately 10 man rem due to distribution, 225 man rem due to use, 1 man rem due to repair, and 250 man rem due to disposal of these watches. Individual dose ranges were calculated for exposures resulting from accidental tube breakage. Conclusive estimates of such doses, however, could not be made for these situations, due to lack of pertinent data.

6771 **Differential effects of cranial radiation on growth hormone response to arginine and insulin infusion.** Dickinson, W.P.; Berry, D.H.; Dickinson, L.; Irvin, M.; Schedewie, H.; Fiser, R.H.; Elders, M.J. (Univ. of Arkansas, Little Rock). *J. Pediatr.;* **92**: No. 5, 754-757(May 1978).

The growth hormone responses to arginine infusion and to insulin-induced hypoglycemia were studied in 13 patients with neoplastic disease after treatment with radiation and chemotherapy. Patients who received intensive cranial radiation (greater than 2,400 rads) had no response to either arginine or insulin; those who received moderate cranial radiation (greater than or equal to 2,400 rads) had GH response to arginine but not to insulin; patients receiving no cranial radiation responded to both arginine and insulin. These data support the hypothesis that GH secretion in response to arginine infusion has a different mechanism in contrast to the response to insulin-induced hypoglycemia and that the latter is more vulnerable to cranial radiation.

6772 **Bone cancer among female radium dial workers. Latency periods and incidence rates by time after exposure: brief communication.** Polednak, A.P. (Argonne National Lab., IL). *J. Natl. Cancer Inst.;* **60**: No. 1, 77-82(Jan 1978).

Bone cancer cases in 1,250 women exposed to radium while working in the luminous watch-dial industry between 1913 and 1929 were analyzed for times of appearance ("latency periods") and incidence rates over time after first exposure. The lowest radium intake dose associated with bone cancer, among 751 women whose intake doses had been determined, was 202.5 μCi. Mean and median bone cancer latency periods tended to decline, but average survival among women without bone cancer also decreased with increasing intake level. Bone cancer incidence rates over time were compared in 2 intake-dose groups (200 to 749 and $\geq$ 750 μCi) by means of an actuarial method that takes competing risks into account. Incidence rates were consistently higher in the higher intake-dose group versus the lower dose group at each 5-year period after first exposure. The variability in the odds ratios across the time periods was not statistically significant, and the actuarial method provided little evidence for an effect of intake dose on the pattern of incidence rate over time. With the use of similar methods, no significant variability was evident in the relative odds of bone cancer over time after exposure between one group of women first exposed to radium at less than 18 years of age and another group exposed when 18 or more years old.

6773 **Physical and medical effects of the Hiroshima and Nagasaki bombs.** *Bull. At. Sci.;* **33**: No. 10, 54-56(Dec 1977).

The following topics are discussed: number of casualties; residual radiation; leukemia; other malignancies; aging and overall mortality; exposure in utero; genetic effects; expansion of A-bomb survival study; and recommendations. (HLW)

6774 **Acute myelogenous leukemia as a late complication of the multimodality therapy for Hodgkin's disease.** Trump, D.L.; Cowall, D.E. (Naval Regional Medical Center, Philadelphia). *Johns Hopkins Med. J.;* **141**: No. 5, 249-251(Nov 1977).

Progressive thrombocytopenia developed in a patient following the completion of total lymphoid irradiation and combination chemotherapy for Hodgkin's disease. Thorough evaluation eventually yielded a diagnosis of acute myelogenous leukemia (AML). Previous workers have suggested that the development of thrombocytopenia with a hypoplastic marrow following total lymphoid irradiation indicated recurrent Hodgkin's disease. When the combination cytopenias and hypoplastic marrow is recognized these workers have recommended early combination chemotherapy. Recent data suggest a 1300-fold increase in the risk of AML following multimodality therapy for Hodgkin's disease. We feel that a careful search for AML should be conducted in patients with deteriorating hematologic parameters following therapy for Hodgkin's disease and that this search should include sampling bone marrow outside irradiated areas.

6775 **Complications of cobalt plaque therapy of choroidal malanomas.** Char, D.H.; Lonn, L.I.; Margolis, L.W. (Univ. of California, San Francisco). *Am. J. Ophthalmol.;* **84**: No. 4, 536-541(Oct 1977).

We treated a small series of patients with choroidal melanomas with radioactive cobalt plaques. To assess the effectiveness of radiation, we performed radioactive phosphorus (^{32}P) uptake determinations before and after treatment. The ^{32}P results did not tumor destruction. In five of seven patients with posterior pole melanomas, radiation retinopathy developed after treatment with resultant decrease in vision.

6776 **Biologic changes due to long-wave ultraviolet irradiation on human skin: ultrastructural study.** Kumakiri, M.; Hashimoto, K.; Willis, I. (Veterans Administration Hospital, Memphis). *J. Invest. Dermatol.;* 69: No. 4, 392-400(Oct 1977).

Alteration of the skin induced by single and repeated long-wave ultraviolet (UVA) exposures was studied. Following a single exposure to relatively large doses of UVA, pronounced dermal damage was observed. In the papillary dermis, superficial dermal vessels showed widely open endothelial gaps and extravasation of blood cells. Marked changes of fibroblasts were also seen in the superficial dermis. In the reticular dermis, extravascular fibrin deposition was seen. After repeated exposures to UVA the formation of cross-banded filamentous aggregations ("Zebra bodies") was observed in the superficial and reticular dermis. These were often found in amorphous masses surrounding the blood vessels. These striking dermal alterations were absent in skin irradiated by solar stimulating radiation and in control skin. Dyskeratotic "sunburn cells" were occasionally seen in the epidermis after single as well as repeated exposures to UVA. The number of these cells was less than that seen after a single exposure to solar simulating radiation.

6777 **Estimation of skeletal calcium in humans by exhaled ^{37}Ar measurement. Evaluation of the fast neutron dose requirement.** Bigler, R.E. (Sloan-Kettering Cancer Center, New York); Laughlin, J.S.; Davis, R. Jr.; Evans, J.C. *Int. J. Nucl. Med. Biol.;* 3: 105-110(1976).

A low dose method for measuring the calcium content of a human subject in vivo is described. This method is pertinent to the diagnosis and monitoring during treatment of patients with metabolic bone disease. The sensitivity of fast neutron activation analysis by the ^{40}Ca(n,α)^{37}Ar reaction has been investigated. A normal male human subject was irradiated using a ^{239}Pu—Be neutron source. Exhaled breath samples were taken over a three hour collection period following the start of a one-half hour irradiation. Whole-body radiation dose was limited to 0.6 mrad. Calculations based upon the results of this experiment demonstrate that a 1% counting error assay can be carried out with as little as 10 mrad radiation exposure and a one day activity analysis.

VERTEBRATES

REFER ALSO TO CITATION(S) 6762

6778 (BNL—24734) **Effects of humoral factors on amplification of nonrecognizable erythrocytic and granulocytic precursors.** Cronkite, E.P.; Carsten, A.L.; Cohen, R.; Miller, M.E.; Moccia, G. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 41p. (CONF-7806105—2). Dep. NTIS, MF A01.

From Hemopoietic stem cell symposium; Upton, NY, USA (12 Jun 1978).

Portions of document are illegible.

The purpose of these studies was to evaluate the effects of humoral factors on amplification of nonrecognizable erythrocytic and granulocytic precursors using the in vivo plasma clot diffusion chamber and the in vitro plasma clot culture methods. Plasma erythropoietin levels changes in the reticulocyte concentration and hematocrits of irradiated and non-irradiated Long-Evans rats exposed to hypoxia were also determined. While erythropoietin plasma levels appeared to effect BFU-E and CFU-E growth, results suggest erythropoietin may not be the sole regulator of red cell production and that inhibitors or chalone-like mechanisms may be involved. Measurements made on granulocyte precursors treated with CSF containing L-cell conditioned medium revealed granulocytic colonies and burst-like formations, similar to those seen for erythrocytic growth. There is strong evidence suggesting that CSF is a regulator of granulopoiesis; however, it is not the sole regulator and it appears that inhibitors may play an in vivo role. Growth of colonies with cell numbers not a power of 2 implies either asymmetric nitosis due to loss of genetic information required for continuing division, or differences in concentration of, or ability to recognize inhibitory factors. These possibilities are examined on the basis of results using in vivo and in vitro culture techniques.

6779 Radiation-induced chromosome aberrations in somatic and germ cells of the male marmoset. Brewen, J.G.; Preston, R.J. (Oak Ridge National Lab., TN). *Primates Med.;* **10**: 199-2040(1978).

The induction of chromosome aberrations by low LET radiations was studied in peripheral lymphocytes and spermatogonial stem cells of the male marmoset. The data showed that there was not significant difference in the sensitivity of the lymphocytes whether they were irradiated in vitro or in vivo, but the frequency of heritable translocations recovered in the primary spermatocytes were considerably lower than that calculated to occur in the lymphocytes. The data are used to make estimates of human genetic risk from radiation based on limited interspecific comparisons.

6780 Dermal toxicity of 8-methoxypsoralen administered (by gavage) to hairless mice irradiated with long-wave ultraviolet light. Langner, A.; Wolska, H.; Marzulli, F.N.; Jablonska, S.; Jarzabek-Chorzelska, M.; Glinski, W.; Pawinska, M. (Warsaw Medical School). *J. Invest. Dermatol.;* **69**: No. 5, 451-457(Nov 1977).

Hairless mice were administered various amounts of 8-methoxypsoralen (8-MOP) by gavage, followed by irradiation with ultraviolet light (UVA) two or more times per week for periods ranging from 1 to 12 months. The minimum phototoxic dose was 20 mg/kg body weight by this route of administration and potential for serious organ toxicity in long-term exposures was investigated. No histologic features of cutaneous malignancy were encountered under test conditions which produced prolonged phototoxicity, deep ulceration, cicatrization, and other deformities. Repeated daily gavaged doses of 20 mg psoralen/Kg body weight in conjunction with twice weekly irradiation for 10 min with UVA elicited an erythematous phototoxic reaction, but did not give rise to subsequent skin lesions. 8-MOP in repeated daily gavage doses of 30 mg and 40 mg/kg body weight combined with twice weekly UVA irradiation for 10 min caused severe burning with subsequent scarring, but did not induce malignant tumors in experiments lasting 8 months. No organ toxicity was seen except for toxic liver changes when severe cutaneous burn and pronounced ulcerations were produced. Limited immunologic studies disclosed no abnormalities in this system.

6781 Radiosensitivity of T and B lymphocytes. V. Effects of whole-body irradiation on numbers of recirculating T cells and sensitization to primary skin grafts in mice. Anderson, R.E.; Williams, W.L. (Univ. of New Mexico School of Medicine, Albuquerque). *Am. J. Pathol.;* **89**: No. 2, 367-378(Nov 1977).

Whole-body exposure of mice to 50, 100, 300, or 500 rads results in an acute dose-related decrease in the number of viable recirculating T cells. The magnitude of this decrement becomes more pronounced with the passage of time. The dose-response relationship over this range of dosages appears to consist of three components: a steep drop between 0 and 50 rads, a plateau between 50 and 500 rads, and a second drop between 300 and 500 rads. The residual radioresistant cells are able to recognize a histoincompatible skin graft during the initial 5 days after irradiation. Low to moderate doses (50 to 300 rads) abrogate the partial tolerance noted in nonirradiated recipients exposed to the skin graft for 5 days and then regrafted from the same donor source 25 days after complete removal of the primary graft. A large (500 rads) dose results in prolonged graft survival in comparison with the nonirradiated group. It is suggested that the subpopulation of recirculating T cells which develops partial tolerance during a 5-day exposure to a homograft is more radiosensitive than the effector subpopulation which is involved in graft rejection.

6782 Ocular effects of ultraviolet radiation from 295 to 365 nm. Pitts, D.G.; Cullen, A.P.; Hacker, P.D. (Univ. of Houston, TX). *Invest. Ophthal. Visual Sci.;* **16**: No. 10, 932-939(Oct 1977).

A 5,000 watt Xe—Hg source and a double monochromator were used to produce 6.6 nm full band-pass ultraviolet (UV) radiation. Pigmented rabbit eyes were exposed to the 6.6 nm band-pass UV radiant energy in 5 nm steps from 295 to 320 nm and at random intervals above 320 nm. Corneal and lenticular damage was assessed and classified with a biomicroscope. Corneal threshold radiant exposure (Hc) rose very rapidly from 0.022 Jcm^{-2} at 300 nm to 10.99 Jcm^{-2} at 335 nm. Radiant exposures exceeding 2 x Hc resulted in irreversible corneal damage. Lenticular damage was limited to wavebands above 295 nm. The action spectrum for the lens began at 295 nm and extended to about 315 nm. Permanent lenticular damage occurred at radiant exposure levels approximately twice the threshold for lenticular radiant exposure. The importance in establishing both corneal and lenticular damage criteria is emphasized.

6783 Comparative pulmonary carcinogenicity of inhaled beta-emitting radionuclides in beagle dogs. Hahan, F.F.; Benjamin, S.A.; Boecker, B.B.; Hobbs, C.H.; Jones, R.K.; McClellan, R.O.; Snipes, M.B. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Inhaled Part.;* **4**: 625-636(Sep 1975).

Beta-emitting radionuclides are important constituents of isotope inventories in light water reactors and may pose an inhalation hazard to industrial workers or the general population if they are released. To study the biological effects of such potential exposures, a series of life span studies was initiated in which beagle dogs were exposed to aerosols of relatively insoluble fused clay particles containing ^{90}Y, ^{91}Y, ^{144}Ce or ^{90}Sr. Groups of dogs exposed to each radionuclide received graded initial lung burdens of radioactivity. When combined with the varied physical half-lives of the four radionuclides, this resulted in a wide variety of radiation doses and dose patterns to the lung. Deaths (greater than 640 days after exposure) were generally associated with pulmonary neoplasia in dogs that inhaled ^{91}Y, ^{144}Ce or ^{90}Sr. These dogs had cumulative lung doses to death greater than 20,000 rads. Exposure to ^{144}Ce or ^{90}Sr with dose rates that decreased slowly induced pulmonary haemangiosarcomas. Pulmonary irradiation from ^{91}Y, with a rapidly decreasing dose rate, resulted in pulmonary epithelial tumors. No malignant lung tumors have been seen within 1540 days after exposure to ^{90}Y. The animals in the main studies have been observed for 1342 to 2756 days after exposure.

6784 Lung response to localized irradiation from plutonium microspheres. Anderson, E.C.; Holland, L.M.; Prine, J.R.; Thomas, R.G. (Los Alamos Scientific Lab., NM). *Inhaled Part.;* **4**: 615-623(Sep 1975).

Uniform spherical 10-micrometer diameter particles of ZrO_2 ceramic, containing various concentrations of PuO_2, have been injected into the jugular vein of Syrian hamsters with subsequent permanent lodgement in the lung capillaries. The number of particles injected has varied from 2000 to 2,000,000 and the specific activity has been from 0.16 to 59 pCi/sphere so that lung burdens range from 0.2 to 700 nCi. To date, approximately 3000 hamsters have been committed to the experiment and two-thirds have died--the expected rate for normal animals. Little biological damage has been observed and only five primary lung tumors have been found that may be due to radiation delivered to the lung. To provide a comparison to more uniform radiation, soluble polonium has also been instilled intratracheally. Results from the microspheres suggest that localized lung irradiation alone is not sufficient cause for tumor induction and is much less hazardous than diffuse exposure.

6785 Ventricular function following radiation damage of the right ventricle. Stone, H.L.; Bishop, V.S.; Guyton, A.C. (Univ. of Mississippi, Jackson). *Am. J. Phys.;* **211**: 1209-1213([nd]).

The right ventricles of four dogs were exposed to 20,000 R ^{60}Co irradiation. The animals were carried through complete stages of: (a) control studies for several weeks, (b) irradiation, and (c) postirradiation studies until death from typical heart failure 23 to 33 days later. Several different types of cardiac function curves were measured at intervals during the control and postirradiation periods. No evident deterioration of the ventricles could be discerned from the function curves during the first 14 days following irradiation. However, during the ensuing 9 to 19 days the ventricles deteriorated rapidly, as evidenced by deteriorating ventricular function curves, terminating in death. Ventricular function, as estimated by the method used in the present study, declined to an average of 43% below that of normal ventricles prior to death of the animal.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

REFER ALSO TO CITATION(S) 6506, 6507, 6508

NUCLIDE KINETICS AND TOXICOLOGY

6786 Uran model study of variability within a compartment. Bernard, S.R. (Oak Ridge National Lab., TN). *Bull. Math. Biol.;* **39**: 463-470(1977).

Formulas are derived for the mean and variance of the number of radioactive atoms present in a compartment (or urn). Initially, n_1 radioactive atoms and b stable atoms are placed in the urn; and subsequently, r stable atoms are added and an equal number, r, of a random mixture of stable and radioactive atoms is removed per unit time. The expected number of radioactive atoms, E(t), present at time t is, as expected, n_1e^{-}/sup lambda t/ where lambda = $(r/\Delta t)/(b + r + n_1)$. The relative variance, $sigma^2(t)/n_1^2$, vanishes to zero for r = 1 atoms per unit time and for a large number of n_1 radioactive atoms; but for a large number of both r and n_1 atoms the relative variance is approximately e $^{-}$/sup lambda t/, equal to the fractional retention, for t > 1/lambda. Thus in studies where radionuclides are injected into animals and a single compartment represents the data, if a large variance is observed it might be due to the fact that large numbers of atoms are transferred out in unit time. When a small variance is observed, this is probably due to the fact that few atoms are transferred in smaller units of time (such that lambda is the same in both cases).

MAN

REFER ALSO TO CITATION(S) 6574

ANIMALS

REFER ALSO TO CITATION(S) 6602, 6604, 6605, 6784, 6792

6787 (NVO—181, pp 221-228) **Solubility of neptunium-234 in an artificial rumen and simulated bovine gastrointestinal fluids.** Barth, J. (Environmental Protection Agency, Las Vegas, NV). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

The alimentary solubility and behavior of neptunium-234 were studied in an artificial rumen and simulated bovine gastrointestinal fluids. Rumen juice was augmented with citrate-buffered neptunium-234 solution and allowed to incubate for 24 hours. This juice was successively converted, by the addition of bile and enzymes and adjustment of the pH, to simulate the digestive stages of the abomasum, duodenum, jejunum, and lower small intestine. Fluid samples were collected from each of these digestive stages and analyzed for soluble neptunium-234 by gamma spectrometry.

6788 (NVO—181, pp 229-241) **Plutonium retention in dairy calves following ingestion of either in vivo labeled or in vitro labeled milk.** Sutton, W.W.; Patzer, R.G.; Hahn, P.B.; Potter, G.D. (Environmental Protection Agency, Las Vegas, NV). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Holstein calves, 4 to 8 days of age, were used to compare the gastrointestinal uptake of plutonium-238 from either in vivo or in vitro plutonium-labeled milk. In vivo labeled milk was collected from intravenously dosed lactating adults and the in vitro labeled milk was prepared at the same nuclide concentration by adding citrate-buffered plutonium nitrate to uncontaminated cow's milk. Dosing was accomplished with individual plastic feeding buckets twice daily for 7 consecutive days. The calves were sacrificed 2 days after the final plutonium dose, at which time tissues were collected for nuclide analysis.

6789 (NVO—181, pp 243-265) **Comparisons of curium-243 and plutonium-238 biological transport in dairy animals following intravenous injection.** Patzer, R.G.; Sutton, W.W.; Hahn, P.B.; Potter, G.D. (Environmental Protection Agency, Las Vegas, NV). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Following citrate-buffered intravenous doses of curium-243 or plutonium-238 to goats and cows, 25 to 40% of the administered radioactivity was found in the liver at periods ranging from 6 to 30 days after dosing. The percent of dose found in skeletal muscle ranged from 1 to 13% over the same time period. The total percent of the administered radioactivity excreted in milk, urine, and feces over a 5- to 6-day period after dosing averaged about 12% for curium-243 and 6% for plutonium-238. Data on the variation among animals in an experiment and on the excretion routes and retention patterns for these radionuclides are presented for dairy cows and goats.

6790 (NVO—181, pp 267-279) **Absorption, distribution, and milk secretion of neptunium in the dairy goat.** Mullen, A.A.; Lloyd, S.R.; Mosley, R.E.; Potter, G.D.; Patzer, R.G. (Environmental Protection Agency, Las Vegas, NV). Nov 1977.

From NAEG Pu program report meeting; Las Vegas, NV, USA (2 Mar 1977).

In Transuranics in desert ecosystems.

Two of three lactating goats confined in metabolism stalls were each given a single oral dose of citrate-buffered neptunium-234 chloride, and the third goat was given a single intravenous dose. During the next 5 days, blood samples and all of the milk, urine, and feces from the goats were collected for neptunium-234 analysis.

6791 Blood and urinary 18F pharmacokinetics following parenteral administration in the rat. Whitford, G.M.; Patten, J.R.; Reynolds, K.E.; Pashley, D.H. (Medical Coll. of Georgia, Augusta). *J. Dent. Res.;* **56**: No. 7, 858-861(Jul 1977).

Blood and urinary excretion time courses of 18F administered parenterally to rats were monitored for two hours. The intraperitoneal, subcutaneous, and intravenous routes gave kinetically indistinguishable results after ten minutes following the dose. The blood time course during the first hour following intramuscular dosing showed a relative constancy and suggested a delayed absorption time.

PLANTS

REFER ALSO TO CITATION(S) 6596, 6600, 6602, 6603

6792 (COO—1156-104) **Radioecology of natural systems. Sixteenth technical progress report, August 1, 1977—July 31, 1978.** Whicker, F.W. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 31 Jul 1978. Contract EY-76-S-02-1156. 42p. Dep. NTIS, PC A03/MF A01.

Major effort during the contract year was devoted to publication of results, with only limited data collection activities. The studies concerning the behavior of plutonium in the terrestrial environs of the Rocky Flats Plant were largely completed one year ago. During the past year, several papers were prepared for publication and several others were either accepted for publication or appeared in print. Three masters these were completed. Some new data were collected on the food habits of mule deer at the Rocky Flats Plant and on the geochemistry of table lead in an alpine lake watershed. Some of these data are summarized herein. Miscellaneous activities related to the funded program are also reported.

THERMAL EFFECTS

PLANTS

6793 Thermal sensitivities of malate dehydrogenase isozymes in Typha. Liu, E.H. (Univ. of South Carolina, Columbia); Sharitz, R.R.; Smith, M.H. *Am. J. Bot.;* **65**: No. 2, 214-220(Feb 1978).

Two species of cattail, Typha latifolia L. and T. domingensis Pers., occur naturally along the shoreline of Par Pond, an 1.128 ha impoundment subjected to intermittent thermal stress at the Savannah River Plant in South Carolina. T. domingensis is not tolerant of the stresses imposed at the hottest section of this lake. Typha latifolia is established throughout the lake but at the hottest section displays an altered morphology compared with stands from ambient areas. Both T. latifolia and T. domingensis are electrophoreticaly monomorphic, and no variation in isozyme expression in ten enzyme systems was recorded in populations from Par Pond. The malate dehydrogenase (MDH) isozyme patterns for T. latifolia and T. domingensis are identical, but their thermal sensitivities differ sharply. All six major T. domingensis MDH isozymes are denatured by heating at 50°C; whereas, T. latifolia has three isozymes which are stable at 50°C and three isozymes which are denatured at this temperature. Tests of thermal stability are more useful than measurements of electrophoretic mobility in detecting enzyme differences and a possible biochemical basis for differences in thermal tolerance in these natural populations.

INVERTEBRATES

6794 (CONF-771042—, pp 138-157) **Use of regression analysis to evaluate environmental effects: exploring methods of analysis.** Beauchamp, J.J. (Union Carbide Corp., Oak Ridge, TN); Gehrs, C.W. Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

The statistical analysis of environmental data presents many interesting problems when the data are taken under field conditions where it is difficult to control factors that may have an effect upon a particular response variable. This paper presents different approaches to the analysis of data from a field experiment that exam-

ined the influence of adult density on production of a calanoid copepod zooplankter. Problems are presented involving the analysis of these data using regression and principal components regression.

6795 Effect of temperature on the hatching time of eggs of Ephemerella ignita (Poda) (Ephemeroptera:Ephemerellidae). Elliott, J.M. (Windermere Lab., Eng.). *Freshwater Biol.;* **8**: No. 1, 51-58(Feb 1978).

Eggs of Ephemerella ignita (Poda) were kept at eight constant temperatures (range 5.9 to 19.8°C) in the laboratory. Over 85% of the eggs hatched in the temperature range 10.0 to 14.2°C but the percentage decreased markedly to 39% at 5.9°C and 42% at 19.8°C. Hatching time (days after oviposition) decreased with increasing water temperature over the range 5.9 to 14.2°C and the relationship between the two variables was well described by a hyperbola. Therefore, the time taken for development was expressed in units of degree-days above a threshold temperature. At higher temperatures, the hatching time and the number of degree-days required for development both increased with increasing temperature. Equations were developed to estimate the number of degree-days required for development at these higher temperatures. Eggs were also placed in the Wilfin Beck, a small stony stream in the English Lake District. Maximum and minimum water temperatures were recorded in each week and the summation of degree-days was used to predict the dates on which 10%, 50% and 90% of the eggs should have hatched. There was good agreement between these estimates and the actual hatching times.

VERTEBRATES

6796 (CONF-771042—, pp 69-75) **Heat shock threshold estimation for fish eggs and larvae in power plant cooling systems.** Marcus, A.H. (Washington State Univ., Pullman). Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

Although mortality and hatching success data are often analyzed by bioassay methods (e.g., probits or logits), it is suspected that actual thresholds exist for the adaptive response of a biological system to multiple environmental stresses. These thresholds can be estimated using a general linear model. The optimal estimation of the response thresholds is a nonlinear least-squares problem, however, and the derivatives of the residual sum of squares surface will have cusps. Approximate confidence regions for thresholds are readily calculated. The separate effects of temperature shock and cumulative temperature dose in electric power plant cooling systems are shown for hatching success of striped bass eggs and for mortality of the larvae of the American shad.

CHEMICALS METABOLISM AND TOXICITY

6797 Respiratory response of guinea pigs to low levels of sulfuric acid. Amdur, M.O.; Dubriel, M.; Creasia, D.A. (Harvard School of Public Health, Boston). *Environ. Res.;* **15**: No. 3, 418-423(Jun 1978).

Sulfuric acid at concentrations of 0.1 to 1 mg/m^3 produces an increase in pulmonary flow resistance and a decrease in pulmonary compliance in guinea pigs exposed for 1 hour. These changes are not rapidly reversible following termination of exposure. Sulfuric acid of 0.3 μm (MMD) was more irritant than a larger size of 1 μm.

6798 Mutagenicity to mammalian cells in culture by (+) and (-) trans-7,8-dihydroxy-7,8-dihydrobenzo(a)pyrenes and the hydrolysis and reduction products of two steroisomeric bzo(a)pyrene 7,8-diol-9,10-epoxides. Huberman, E. (Oak Ridge National Lab., TN); Yang, S.K.; McCourt, D.W.; Gelboin, H.V. *Cancer Lett. (Amsterdam);* **4**: 35-43(1977).

The mutagenicity for mammalian cells of benzo(a)pyrene (BP) and 9 of its derivatives was tested by resistance to obtain in Chinese hamster V79 cells. The derivatives included the (-) and (+) enantiomers of trans-7,8-diol; the racemic (+-)trans-7,8-diol; two triols, (7/8,9)-triol and (7,9/8)-triol; and four tetrols, (7,10/8,9)-tetrol, (7/8,9,10)-tetrol, (7,9/8,10)-tetrol and (7,9,10/8)-tetrol. Since V79 cells do not metabolize polycyclic hydrocarbons, mutagenesis was tested both in the presence and in the absence of Golden hamster cells capable of metabolizing polycyclic hydrocarbons. Neither BP nor any of its 9 tested derivatives showed mutagenicity for V79 cells in the absence of normal Golden hamster cells. However, in the presence of these cells, BP and the optically active and racemic trans-7,8-diols exhibited a mutagenic response that was dose-dependent. All other derivatives were inactive. The most active mutagenic hydrocarbon was (-)trans-7,8-diol, and activity decreased in the order (+-)trans-7,8-diol, (+)trans-7,8-diol and BP.

MICROORGANISMS

REFER ALSO TO CITATION(S) 6749, 6802

6799 Cadmium toxicity in planktonic organisms of a freshwater food web. Fennikoh, K.B.; Hirshfield, H.I.; Kneip, T.J. (New York Univ.). *Environ. Res.;* **15**: No. 3, 357-367(Jun 1978).

The effects of cadmium chloride on population growth of two species of green algae were determined in 168-hour bioassays, and six additional freshwater species were studied using 96-hour LC_{50} measurements. Intercomparisons of these two test series show that limits generated by a 100-fold reduction of the 96-hour LC_{50} values would protect planktonic species from the observable effects on life span, growth, or reproduction. The limits generated by these laboratory studies are in the range of concentrations observed in a field study of a contaminated estuarine cove. However, field exposures vary with the tide, and the hardness of the laboratory water is considerably lower than that of the water in the cove. These factors probably account for the absence of observable effects on planktonic population in the affected cove.

6800 Influence of pH on inhibition of bacteria, fungi, and coliphages by bisulfite and sulfite. Babich, H.; Stotzky, G. (New York Univ.). *Environ. Res.;* **15**: No. 3, 405-417(Jun 1978).

Studies were performed to determine the effects of bisulfite (HSO_3^-) and sulfite (SO_3^{2-}), the anionic solubility products of sulfur dioxide (SO_2), on the growth of bacteria and fungi and on the survival of a coliphage. Although differential sensitivities to these anions were noted among the test microorganisms, HSO_3^- was always more inhibitory than SO_3^{-2}. The inhibitory effects of HSO_3^- and SO_3^{-2} were pH dependent: The lower the pH, the greater their toxicity. Consequently, when evaluating the overall effects of pollution by SO_2 and the resultant acid rain on the biosphere, attention must be focused on the anionic solubility products of SO_2 and on the impact of the pH of the receiver environment on their toxicity to microbes.

6801 Inhibition of light-induced pH increase and O_2 evolution of marine microalgae by water-soluble components of crude and refined oils. Armstrong, J.E.; Calder, J.A. (Florida State Univ., Tallahassee). *Appl. Environ. Microbiol.;* **35**: No. 5, 858-862(May 1978).

Light-induced alkalinization of the extracellular medium was found to be a common feature of the primary photosynthetic process of several marine microalgae. The light-induced pH increase of suspensions of whole cells was immediately and severly inhibited by a single dose of water-soluble components from crude and fuel oils. Differential effects on the rates of microalgal photosynthetic O_2 evolution and cell suspension pH increase suggest different toxicity mechanisms of the water-soluble components of no. 2 fuel oil as compared with Southern Louisiana and Jay Crude oils. These short-term studies on the nature of sublethal petroleum toxicity to microalgae indicate that the primary effect may be through direct action on the energy-yielding electron transport systems.

PLANTS

REFER ALSO TO CITATION(S) 6645, 6646, 6834

6802 Effects of simulated acidic rain on host-parasite interactions in plant diseases. Shriner, D.S. (North Carolina State Univ., Raleigh). *Phytopathology;* **68**: 213-218(1978).

The effects of simulated rain acidified with sulfuric acid were studied on five host-parasite systems. Plants were exposed in greenhouse or field to simulated rain of pH 3.2 or pH 6.0 in amounts and intervals common to weather patterns of North Carolina. Simulated acidic rain resulted in: (1) an 86 percent inhibition of the number of telia produced by Cronartium fusiforme on willow oak (Quercus phellos); (2) a 66 percent inhibition in the reproduction of root-knot nematode (Meloidogyne hapla) on field-grown kidney beans (Phaseolus vulgaris "Red Kidney"); (3) a 29 percent decrease in the percentage of leaf area of field-grown kidney beans affected by Uromyces phaseoli; and (4) either stimulated or inhibited development of halo blight on kidney bean (caused by Pseudomonas phaseolicola), depending upon the stage of the disease cycle in which the treatments were applied. The effect varied as follows: (1) simulated acidic rain applied to plants before inoculation increased disease severity by 42 percent; (2) suspension of bacteria in acidic rain resulted in no infection; and (3) acidic rain applied to plants after infection inhibited disease development by 22 percent. Results suggest that the acidity of rain is an environmental parameter which should be of concern to plant pathologists and agricultural and forest ecologists.

VERTEBRATES

REFER ALSO TO CITATION(S) 6625, 6635, 6766, 6787, 6814

6803 (UR—3490-1412) **Differential toxicity of sodium fluoroacetate for liver, kidney and testis in the rat.** Sullivan, J.L. (Rochester Univ., NY (USA)). 1976. Contract EY-76-C-02-3490. 79p. Dep. NTIS, PC A05/MF A01.

Thesis.

This problem attempted to correlate selected biochemical responses with accompanying histologic changes seen in the testis, kidney, and liver of rats receiving NaFAc in their water supply. Groups of rats were placed on special low fluoride rat chow and distilled water for one week after which time FAc was added to the drinking water in concentrations of 20, 6.6, and 2.2 ppM NaFAc. Animals were sacrificed daily from each dosage group through 7 days. All remaining rats were then changed to distilled water and sacrificed at intervals during the succeeding 21 days. Growth rates were decreased during the early part of treatment in all dosage groups, but the general growth curves indicated an adaptation to the effects of the toxin. ATP and citrate concentrations in the liver were not significantly affected. In the kidney, there were transient increases in citrate concentration in the 20 and 6.6 ppM group but not in the 2.2 ppM group. Renal ATP levels were variable, but not significantly decreased. Histologic damage in the liver and kidney was not evident. The most striking changes seen were encountered in the testis. Organ weight was significantly decreased by the seventh day of treatment in the 20 and 6.6 ppM groups, and remained so throughout the 21 day post-treatment period.

6804 **Cardiovascular adjustments to carbon monoxide exposure during rest and exercise in dogs.** Wagner, J.A.; Horvath, S.M.; Dahms, T.E. (Univ. of California, Santa Barbara). *Environ. Res.;* **15**: No. 3, 368-374(Jun 1978).

Cardiovascular, respiratory, and metabolic measurements were made on dogs at rest and during 30 minutes of exercise at either 6.4 km/hour, 10% grade, or 8.0 km/hour, 16% grade, following the bolus administration of CO for 1 or 2 minutes, or room-air breathing mixtures. During rest and exercise elevated mean blood HbCO levels (6 to 21%) reduced the arterial and mixed venous oxygen contents and saturations, and mixed venous P/sub O_2/ levels. Arterial-mixed venous oxygen differences were reduced during exercise as a result of CO administration. Elevated blood HbCO levels had a minimal or no effect on other cardiovascular, respiratory, and metabolic parameters. During work the reductions in a-anti v/sub O_2/ differences were not offset by appropriate increases in cardiac outputs.

6805 **Aspects of the biology and heavy metal accumulation of Ciliata mustela.** Badsha, K.S.; Sainsbury, M. (Univ. of Bath, Eng.). *J. Fish Biol.;* **12**: No. 3, 213-220(Mar 1978).

The feeding habits, rates of growth, fecundity and other aspects of the general biology of five-bearded rockling from the Severn Estuary and the Bristol Channel are reviewed for the period 1974/76. Additionally the changes in heavy metal accumulation during this time have been measured and an attempt has been made to relate them to the diet of the fish.

6806 **Sensory irritation and incapacitation evoked by thermal decomposition products of polymers and comparisons with known sensory irritants.** Barrow, C.S.; Alarie, Y.; Stock, M.F. (Univ. of Pittsburgh). *Arch. Environ. Health;* **33**: No. 2, 79-88(1978).

A decrease in respiratory rate in mice during exposure to irritating airborne chemicals has been utilized as a response parameter to characterize the degree of upper respiratory tract irritation (sensory irritation) to the thermal decomposition products of various polymers. These included polystyrene, polyvinyl chloride, flexible polyurethane foam, polytetrafluorethylene, a fiber glass reinforced polyester resin, and Douglas Fir. Each of the materials was thermally decomposed in a low-mass vertical furnace in an air atmosphere at a programmed heating rate of 20°C/min. Mice, in groups of four, were exposed to graded concentrations of the thermal decomposition products of each of the above materials. Dose-response curves were obtained by utilizing the maximum percent decrease in respiratory rate as the response parameter during each exposure. Comparison of these dose-response curves with other sensory irritants such as chlorine, ammonia, hydrogen chloride, sulfur dioxide, and toluene diisocyanate gave an indication of the sensory irritation potential of the thermal decomposition products of these various polymers versus that of well-known single airborne chemical irritants. Total stress and incapacitation of the organism during exposure to ensory irritants such as from the thermal decomposition products of synthetic polymers is discussed.

6807 **Whole animal as an assay system.** Weiss, B. (Univ. of Rochester, NY). pp 53-66 of Environmental pollutants: detection and measurement. Toribara, T.Y.; Coleman, J.R.; Dahneke, B.E.; Feldman, I. (eds.). New York; Plenum Press (1978).

From 10. conference on environmental toxicity; Rochester, NY, USA (23 May 1977).

Advances in our ability to detect and measure environmental contaminants and their tissue products parallel our new emphasis on incipient functional impairment and long-range risk estimates as indices of toxic effects. Death and overt pathology no longer are credible criteria by which to set environmental standards. By turning to functional criteria, however, we provoke a new set of vexing problems, namely, how to define toxicity. Among the factors that blur such a definition are the following: How do we subsume adaptive and compensatory mechanisms. How do we take account of non-specific subjective complaints. How shall we incorporate the responses of susceptible populations such as the very young, the very old, and constitutional predispositions to adverse responses. Behavior exemplifies many of these problems of definition because it encompasses so many functions and because toxic end points are merely arbitrary stages in a continuum. It is an indispensable criterion, however, because it is the whole animal that responds—that dies, or grows weak or becomes irritable and depressed. The impact on its welfare is what defines an agent as a pollutant.

6808 **Influence of spironolactone on the excretion of $^{203}Hg^{2+}$ in rats.** Cikrt, M.; Tichy, M. *Environ. Res.;* **10**: 3, 427-433(1975).

The effect of Spironolactone (SPL) on $^{203}Hg^{2+}$ excretion was studied in rats with particular attention to mercury excretion via the bile. No correlation was found between the number of SPL (premedication by 1 to 5 doses of 5 mg SPL/100 g body weight) and the cumulative bile excretion of $^{203}Hg^{2+}$ during 6 hours after an i.v. administration of 120 μg Hg^{2+} per rat. After SPL premedication there was a statistically significant increase of mercury excretion in stool 24 hrs after an i.v. administration of $^{203}Hg^{2+}$. A simultaneous peroral administration of the sorbent containing SH-groups had no effect on mercury excretion in stool. Repeated administrations of $^{203}Hg^{2+}$ (5 hours after the first dose) produced a statistically significant increase of mercury excretion via bile in rats which had previously received SPL. Conversely, repeated administrations of SPL (4 hours after i.v. application of mercury) failed to influence mercury bile excretion. The results indicate that the effect of SPL on mercury bile excretion is limited by the level of "accessible mercury" in the organism and could be determined by direct interaction of the mercury and SPL molecules.

MAN

REFER ALSO TO CITATION(S) 5146, 5359, 6545, 6733

6809 (ORNL/TIRC—76/3) **Kepone. I. A literature summary. II. An abstracted literature collection, 1952—1977.** Huff, J.E.; Gerstner, H.B.; Black, S.A. (Toxicology Information Response Center, Oak Ridge, TN (USA)). Sep 1977. Contract W-7405-ENG-26. 51p. Dep. NTIS $15.00.

Studies on the pesticide kepone, the trade name for chlordecone, are reviewed under the following headings: literature; history; substance identification; uses; environmental vigilance; epidemiology; signs and symptoms; toxicology; carcinogenicity; and related health problems. A bibliography of 175 references with abstracts is included. (HLW)

6810 **Lead determination in the blood of uranium miners using atomic absorption spectrophotometry.** Nosek, J.; Mohyla, O.; Pehr, F. *Prac. Lek.;* **28**: No. 7, 230-232(1976). (In Czech).

Atomic absorption spectrophotometry was used to determine repeatedly lead contents in the venous blood of 200 uranium miners. There was found a linear regression between the lead concentrations in blood and the length of exposure: mean Pb concentration in blood after 5 years was 1.08 μM, after 10 years—1.13 μM, after 15 years—1.19 μM, after 20 years—1.25 μM, after 25 years—1.30 μM Pb. The increase in Pb concentrations occurred regardless of the physical age of exposed persons.

6811 **Occupational diseases and industrial poisonings in Czechoslovakia in 1974.** Suntych, F. *Prac. Lek.;* **56**: No. 10, 379-383(1976). (In Czech).

In 1974, 4747 new cases of occupational diseases and poisoning were reported in Czechoslovakia, approximately the same number as in several preceding years. The numerically largest group affected were farm workers, followed by workers in the mining and power industry, health service, engineering plants, etc. Occupational infections were the largest in number, followed by skin diseases (excluding skin infections), pneumoconioses and industrial poisonings. Another 84 health impairments have been reported which, as yet, are not included in the list of occupational diseases.

6812 **Effect of external environment on late skin porphyria.** Chlumsky, J.; Malina, L. pp 272-274 of Clovek a jeho vztah k zivotnimu prostredi, Praha 21—23 May 1975. Prague; Lekarska Fakulta Hygienicka (1976). (In Czech)

Occupation-related causes of late skin porphyria were analyzed in 115 patients. 17% of cases were found to be occupationally exposed to lead or tetraethyl lead, 16% worked with UV and solar radiation and only 2 patients (1.7%) were found to be exposed to industrial chemicals. In some patients the causative agent overlapped and often was combined with the intake of alcohol (40%), other

combinations were liver trouble (32.5%), TB (17.5%) and diabetes (10%).

6813 Pathomorphology of asbestosis in persons working with asbestos. Dobias, J. pp 259-262 of Clovek a jeho vztah k zivotnimu prostredi, Praha 21—23 May 1975. Prague; Lekarska Fakulta Hygienicka (1976). (In Czech)

Autopsy was performed in 19 deceased persons whose disease had originated in an asbestos processing plant in Zverinek. The results lead to a conclusion that long-term exposure to asbestos results in advanced stages in a fibrotic or cancerogenic changes in lung tissues. Fibrous changes on visceral pleura were typical, hyaline plaques on parietal pleura were not demonstrably characteristic. In the initial stages, fibrogenity of lung tissues was difficult to diagnose without clinical correlation.

6814 Exposure to carbon disulphide and its effect on carbohydrate metabolism. Kujalova, V. pp vp of Proceedings of Congress of the Hungarian Society of Occupational Health, Budapest, Hungary, October 1976. Budapest; Hungarian Society of Occupational Health (1976). (In Hungarian)

Chronic exposure to carbon disulphide (CS_2) has an interfering effect on pyridoxine metabolism which manifests itself by an increased excretion of xanthuric acid (XA) after tryptophane load and by a decreased excretion of pyridoxine acid (4-PA). XA is known to have a diabetogenic effect; therefore, glucose tolerance was studied in rats exposed chronically to CS_2. When using cortisone GTT, the intoxicated animals showed significantly elevated levels of glycemia one hour after glucose application. The workers occupationally exposed for more than 10 years to CS_2 were found to have in 59% of cases impaired glucose tolerance according to the triamcinol on test, the curve of the immunoreactive insulin exhibited a shift and higher levels with a delayed return to normal values. The impairment corresponds to the picture of "oxyhyperglycemia."

6815 Exposure of customs officers at Hrensko frontier pass to exhaust gases. Cabicar, J.; Vesely, V. *Cesk. Hyg.;* **21**: No. 3, 124-127(1976). (In Czech).

Working conditions of 34 customs and passport control officers (of these 6 women) at the Hrensko frontier pass were examined with respect to their exposure to automotive pollution. About 600 to 1000 cars cross here, usually the border, during a 12-hour shift. The officers alternate 1-hour work with 1-hour rest. SO_2 in the atmosphere ranged up to 0.4 mg/m^3, CO from 0.001 to 0.02 vol percent, nitrogen gases from 2.6 to 3.2 mg/m^3. Lead occurred only in traces, noise was usually below 80 dB (A). Nonetheless, lead exposure tests indicated a higher exposure value (DALA in urine was in 12 percent of cases over 10 mg/l, activity of DALA dehydratase in erythrocytes was below 80 percent in 50 percent of cases), carbonylhemoglobin ranged between 5 to 10 percent, sporadically up to 12 percent.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 5149

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 6506, 6507, 6508

6816 Determination of carbon monoxide in industrial exhalates. Lepsi, P.; Skalicka, B. *Chem. Prum.;* **26**: No. 6, 294-296(1976). (In Czech).

The proposed method for the determination of carbon monoxide can replace infrared spectrometry and gas chromatography provided that discontinual measurements are concerned at the complete elimination of interfering components. The principle of this carbon monoxide determination is based on oxidation with the Schuetz agent. Carbon dioxide formed by oxidation is determined by titration or gravimetrically in accordance with the concentration of carbon monoxide in the original sample. Samples are pumped into rubber bags of at least 51 volume and analyzed within 4 hours after sampling. At a presumed concentration of CO in the range 0.05 to 1 percent vol., after oxidation with the Schuetz agent and after absorption in 0.05 N barium hydroxide, the concentration of CO was determined by titration with 0.05 N HCL. CO in a gas mixture for concentrations ranging from 1.0 to 15.0 percent vol. was determined gravimetrically after oxidation of CO to carbon dioxide.

GEOSCIENCES

6817 (DOE/ER—0016) **Summaries of physical research in the geosciences.** (Department of Energy, Washington, DC (USA). Div. of Basic Energy Sciences). Sep 1978. 56p. Dep. NTIS, PC A04/MF A01.

The Department of Energy supports research in the geosciences in order to provide a sound underlay of fundamental knowledge in those areas of the earth, atmospheric, and solar/terrestrial sciences which relate to DOE's many missions. This research may be conducted in the major DOE laboratories, industry, universities and other government agencies. Such support provides for payment of salaries, purchase of equipment and other materials, an allowance for overhead costs, and is formalized by a contract between the Department and the organization performing the work. The summaries in this document, prepared by the investigators, describe the work performed during 1977, include the scope of the work to be performed in 1978 and provide information regarding some of the research planned for 1979. The Division of Engineering, Mathematics, and Geosciences, which is a part of the Office of Energy Research, supports, under its Geoscience Program, research in geology, petrology, geophysics, geochemistry, hydrology, solar-terrestrial relationships, aeronomy, seismology and natural resource analysis, including the various subdivisions and interdisciplinary relationships, as well as their relationship to the Department's technological needs.

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 6493, 6495, 6497, 6607, 6608, 6609, 6610, 6611, 6612

6818 (ORNL/TM—5893) **Interactive programs for low-flow frequency analyses for use in regional studies.** Hyndman, J.R.; Huff, D.D. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 117p. Dep. NTIS, PC A06/MF A01.

Seven-day ten-year low-flow values have been used as indices of water availability for regional energy facility siting. This paper describes an automated system for generating low-flow frequency distributions for United States Geological Survey streamflow gaging sites. Since no single frequency distribution will match the low flow frequencies at all stream gaging stations, it is necessary to examine several possible distributions for each station to determine the most useful one. Four representative low flow frequency distributions, Gumbel's limited distribution of the smallest value, the Pearson Type III, the Log-Pearson III, and the Log-Normal distributions, have been chosen for inclusion in an interactive set of programs, named LOFL02. LOFL02 forms one analysis module of the ORNL Water Analysis System (WAS), and when used in conjunction with other WAS programs makes frequency analysis viable on a regional scale by facilitating the handling of large amounts of data for large numbers of stations.

6819 (SAND—78-0011C) **Particle tracing techniques for flows in porous media.** Fox, R.L.; Eaton, R.R.; Krueger, D.A. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 8p. (CONF-780711—2). Dep. NTIS, PC A02/MF A01.

From 11. AIAA fluid and plasma dynamics conference; Seattle, WA, USA (10 Jul 1978).

Portions of document are illegible.

The prediction of flow in porous media has been of both current and historical interest. Recent developments, for example, in the in-situ gasification of coal, the removal of hydrocarbons from oil shale, and the extraction of oil and gas require an in-depth understanding of flow in porous geologic media. Existing procedures for investigating these problems require more empirical input than should be necessary if the porous media were adequately described by the computational scheme. The purpose of this paper is to develop a particle tracing scheme for calculating flows in porous media which will reduce the number of required empirical properties, such as permeability, and have application to more general flow regimes such as non-Darcy flows.

6820 Application of image analysis to formation evaluation. Rink, M.; Schopper, J.R. (Technische Universitaet, Clausthal, DE). pp 23, Paper 17 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977).

From 5. European logging symposium; Paris, France (20 Oct 1977).

A procedure for the image analysis of rock pores is described. Petrophysical quantities of porosity, capillarity, and permeability are derived from the image analysis data. Examples are given of the application of the technique and derived petrophysical data to the evaluation of formation rock. (JSR)

GEOPHYSICS

6821 (LA—7419-MS) **Gravity survey of the Pajarito Plateau, Los Alamos and Santa Fe Counties, New Mexico.** Budding, A.J. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

A Bouguer anomaly map of the Pajarito Plateau, based on more than 200 gravity stations, shows a NNE-trending low of 18 milligals, centered 4.5 km southeast of Los Alamos. Interpretation based on a geologic column, which includes Precambrian crystalline rocks, Carboniferous sediments, early Tertiary El Rito and Abiquiu Formations, late Tertiary Santa Fe Group, and late Tertiary and Quaternary volcanics and sediments, shows that the gravitational low could be the result of a NNE-trending graben, not expressed in the surface geology. The graben is about 10 km long and 5 km wide. It appears that the deepest part of the Espanola Basin of the Rio Grande rift zone is along the west side, where as much as 2300 m of Santa Fe Group sediments could be present.

SEISMOLOGY AND TECTONICS

6822 (NUREG—0029(Vol.2)) **Geotechnical and strong motion earthquake data from U.S. accelerograph stations: Pasadena (CIT Millikan Library), Santa Barbara County Court House, Taft (Lincoln School Tunnel), and Hollister (Melendy Ranch Barn), California.** Arango, I. (Shannon and Wilson, Inc., Seattle, WA (USA); Agbabian Associates, El Segundo, CA (USA)). Jun 1976. 283p. NTIS $11.00.

Seismic and geotechnical data for four accelerograph stations located in the southern and central part of California are presented. These stations are located at Pasadena, Santa Barbara, Taft, and Hollister.

6823 **Characteristics of rock disintegration with internal friction and dilatancy.** Nikitin, L.V.; Ryzhak, E.I. (Inst. of Physics of the Earth, Moscow). *Izv. Akad. Nauk SSSR, Fiz. Zemli;* No. 5, 22-37(May 1977). (In Russian).

A study is made of the characteristics of rock disintegration with internal friction and dilatancy. Disintegration is interpreted as a manifestation of internal instability inherent in a specific law of the material concerned. The energy criterion of instability which accounts for boundary conditions is taken as the criterion of disintegration. The constraining action of boundary conditions gives rise to the partial or complete localization of deformations. A determination is made of the orientation of localization layers and their number is evaluated in reference to the character of constraint.

6824 **Direct measuring of heat flows from interior part of the Earth in boreholes.** Kutas, R.I.; Bervzyuk, M.I.; Gerashchenko, O.A.; Grishchenko, T.G. (Inst. of Geophysics, Kiev). *Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz.;* No. 76, 79-81(1977). (In Russian).

The borehole equipment is described for combined measuring of temperature and heat flow. Temperatures are measured with thermoresistor and heat flow sensor. Results of examinations are presented for several regions of the Ukr.SSR territory.

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 6492

6825 **Possibility to solve dynamic problems of seismic surveying of horizontal-layered media without considering multiple reflections (numerical experiment) II.** Lossovskii, E.K.; Bervzyuk, M.I.; Osinovskaya, L.I. (Inst of Geophysics, Kiev). *Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz.;* No. 76, 3-11(1977). (In Russian).

The mathematical statement correlating the number of layers with wave amplitudes is proved for a plane-parallel multilayered medium of random acoustic structure. The statement shows the possibility of solving some direct and inverse dynamic problems of multilayered media taking no account of multiple reflections. This conclusion is obtained on the model of layered medium described statistically. The latter means that the results of the given work exceed the bounds of a horizontal homogeneous medium postulated initially and within the limits of the given dispersion of the elastic properties sigma^2 are also valid for layered media heterogeneous in horizontal direction.

6826 **Spectrum synthesis of interference systems to separate signals in seismic records.** Gerasimenko, A.N. (Inst. of Oil and Gas, Ivano-Frankovsk, USSR). *Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz.;* No. 76, 23-35(1977). (In Russian).

The problem is on synthesis of frequency characteristics of a certain system performing a combined separation of interfering signals in a seismic record. The principle of its action is considered in detail on the example of the second order system. For systems of arbitrary order the sought for frequency characteristics are obtained as amplitude and phase ratios. The method of solving the problem on combined separation of signals consists in conversion of the Fourier transformation matrix of the seismic record mathematical model. The mathematical model is a system of linear-operator equations. Seismic waves are supposed to be plane waves, their seeming velocities are supposed to be within ranges of ν^* min $< \nu^* < \nu^*$ max.

6827 **Stratigraphic interpretation of seismic data.** Rainon, E.; Joncheray, B. pp 22p, Paper 6 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977). (In French)

From Conference on the problems of radioactive wastes in nuclear technology; Essen, F.R. Germany (20 Oct 1977).

A procedure for the stratigraphic interpretation of seismic data, which uses relative velocities rather than absolute or low frequency velocities, is outlined. Examples are given to illustrate the stratigraphic information that can be obtained from the processed seismic data. (JSR)

6828 **Seismic applications of well logs.** Dupal, L.; Gartner, J.E.; Vivet, B. (Schlumberger Technical Services, Paris). pp 13p, Paper 8 of Actes du troisieme colloque annuel de diagraphies. Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977).

From Conference on the problems of radioactive wastes in nuclear technology; Essen, F.R. Germany (20 Oct 1977).

Log information has come into increasing widespread use as a means of refining and corroborating seismic data and interpretations. The logs used are the Sonic (recalibrated by check shots with the Well Seismic Tool, WST) and Density (corrected for rugosity and invasion through computer processed interpretation). With these higher-quality data, the GEOGRAM program is used to generate synthetic seismograms on any seismic line passing through or near the borehole. Usually dip information from the high-resolution Dipmeter is used to provide realistic structural projections beyond the borehole. Alternatively, the computation can be made assuming any desired structure, in an attempt to obtain a good fit with the seismic data. Then the seismic surveys can be interpreted in the light of the GEOGRAM results, and reprocessed if needed, greatly improving the accuracy, detail, and reliability of these basic geophysical techniques.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 5342, 5346

6829 (LBL—7074) **Mechanical properties of Stripa granite.** Swan, G. (Tekniska Hoegskolan, Luleaa (Sweden)). 8 Aug 1978. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

The mechanical properties of Stripa granite are presented as determined from small (laboratory size), oven-dried specimens. The properties determined include Young's modulus, Poisson's ratio, unaxial compressive fracture stress, and the expansion coefficient, all as a function of temperature. In addition, the Brazilian tensile fracture stress, residual shear strength as a function of a normal stress and the rock's anisotropy ratios are presented. Finally, ultrasonic determinations at 1 MHz of the rock's dilatational wave velocity are given and the deduced Young's modulus is compared with the static value for room temperature.

6830 **Hydrofracturing stress measuring method and recent field results.** Haimson, B.C. (Univ. of Wisconsin, Madison). *Int. J. Rock Mech. Min. Sci. Geomech. Abstr.;* **15**: No. 4, 167-178(Aug 1978).

The hydrofracturing technique is a recent development in the area of stress measurements in rock. Unlike most other methods, it does not measure strain at a point through the use of delicate instrumentation in the test-hole. Rather, it directly determines average stresses over large areas by recording two hydraulic pressures, one necessary to crack open a segment of the test-hole and the other required to keep the fracture open. To do so, it uses simple downhole mechanical tools so that the method can be employed at any depth from the surface. Elementary elastic relationships exist between recorded pressures and in situ stresses, and between fracture direction and stress orientation. Our laboratory experiments have confirmed these relationships, and in the last five years we have conducted a number of successful field measurements throughout the United States and elsewhere, at depths between very near the surface and 5000 m. The results of these measurements, details of which are given in the paper, have been used in studying earthquake control problems (Rangely, Colorado), underground power station design (California, South Carolina), hard rock tunnel design (Wisconsin), and geology and plate tectonics (all the measurements and particularly those in Michigan and Iceland). A general uniformity of maximum principal stress direction throughout the continental United States has been established. Stress magnitudes are affected by

regional geologic conditions but generally show linear increases with depth. 17 figs., 4 references.

6831 Simplified method of determining the long-term strength of rocks. Afanasev, B.F. *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 2, 219-221(Mar 1978).

This paper reports a simplified version of a previously published strength relaxation method, which can be used to determine the long term strengths of rocks under compression, shear, rupture, flexure and torsion.

6832 Variation in the elastic properties of a rock mass with depth. Baikonurov, O.A. *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 2, 148-152(Mar 1976).

This paper reports measurements of P and S wave velocities and Poissons ratio in grey sandstone at Dzhezkazgan, and the identification of different zones in the rock at different depths.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 6792

6833 (USGS-OFR—77-279) **Environmental assessment of hydrocarbons in Mid-Atlantic Shelf sediments: 1975—1976 USGS-BLM Program.** Miller, R.E.; Schultz, D.M.; Ligon, D.; George, B.; Doyle, D. (Geological Survey, Washington, DC (USA)). 1977. 43p. Geological Survey, Washington, DC.

During 1975—1976, an environmental assessment program was carried out to establish baseline concentration levels of hydrocarbons in the surface sediments of the Mid-Atlantic Shelf where leasing for petroleum exploration is anticipated. Reported here are the results of the individual hydrocarbon analyses for 150 composite surface-sediment samples. The following geochemical parameters were determined for each composite sample: (1) Total lipid recovered (ug/g sediment); (2) n-alkane components (hexane eluate) as resolved by gas chromatography (ug/g sediment); (3) Resolved benzene eluate (ug/g sediment)k; (4) N-alkane odd-even ratio; (5) Isoprenoid alkane/n-alkane ratio; (6) Pristane/phytane ratio; (7) Pristane/n-C_{17} ratio; (8) Phytane/n-C_{18} ratio; and (9) Normal alkane/branched alkane ratio. Summary analyses of these parameters for each sampling season are detailed in this report. The Mid-Atlantic Shelf sediments, in general, have been found to contain very low concentrations of aliphatic hydrocarbons, usually less than 5.0 μg/g sediment. Mass spectral analyses of selected hexane eluates confirmed the presence of a series of normal aliphatic alkanes ranging from n-C_{16} to n-C_{31} as well as the isoprenoids pristane and phytane. A series of three hydrocarbon peaks in the n-C_{20} to n-C_{21} range were tentatively identified as n-C_{25} unsaturated, branched homologs. There are virtually no aromatic hydrocarbons in the benzene eluate; rather, methyl esters are the dominant components. Preliminary indications are that transesterification occurs during saponification accompanying the analytical procedure.

6834 (USGS-OFR—77-872) **Geochemical survey of the western energy regions. Fourth annual progress report, July 1977.** (Geological Survey, Denver, CO (USA)). 1977. 231p. Geological Survey, Washington, DC.

Portions of document are illegible.

This is the fourth in a series of annual reports describing field studies in environmental geochemistry of the western energy regions. To date, field collections are complete for 36 regional landscape units spread throughout the Northern Great Plains, the Powder River, Bighorn and Wind River Basins, the oil shale region of Colorado, Utah and Wyoming, and the San Juan Basin of New Mexico. These units include bedrock formations, stream sediments, ground waters, and soils and plants of various kinds. Complete or partial chemical data have been evaluated for 30 of the 38 units; probable upper limits of element concentration to be expected in these materials are given. In addition to the regional surveys, a wide variety of topical work has been undertaken, much of it focusing on problems of geochemical change in native vegetation due to power-plant operation or strip-mine reclamation. Topical work described in this report includes: a brief examination of downstream geochemical effects below an abandoned strip mine; additional work on potential element contamination around the Dave Johnston Powerplant, Wyoming; standardization of laboratory techniques for studies of element availability in soils and rocks; examination of geochemical zonation in oil shale; and a study of trace element changes in wheat grown on strip-mine spoils. 120 references.

6835 (USGS-OFR—78-116) **Mercury analyses of sediments from cores in Clear Lake, Lake County, California.** Sims, J.D. (Geological Survey, Washington, DC (USA)). 1978. 8p. Geological Survey, Washington, DC.

Cores of late Quaternary sediments were collected from several sites in Clear Lake. Samples from two of these cores were analyzed for their mercury content as part of a study on the time of emplacement of the mercury ore body at the nearby Sulphur Bank mine. The samples were analyzed in laboratories of the U.S. Geological Survey by the mercury vapor detector method. The accuracy of this method is discussed.

6836 Use of the spontaneous potential curve in a mineral mapping technique. Hallenburg, J.K. pp U1-U12 of Transactions of the SPWLA nineteenth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1978).

From 19. logging symposium; El Paso, TX, USA (13 Jun 1978).

The spontaneous potential curve is a record of several components. The use of the diffusion-absorption component to determine formation water resistivity is well known. A technique is proposed which appears to reflect changes of the redox components. A mapping technique is proposed which may be useful in locating sedimentary mineral trends. A hypothesis is advanced which may partially explain several observed phenomena.

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 6634

PHYSICS RESEARCH

6837 Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977). 684p. (In English and French). (CONF-760746—). $29.50.

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The conference contained 64 papers, three of which appeared previously in ERA. Separate abstracts were prepared for 25 papers. Other papers were outside the subject scope of ERA. (JFP)

ASTROPHYSICS AND COSMOLOGY

STARS

REFER ALSO TO CITATION(S) 6953

6838 (LA-UR-—78-2026) **Supernova type I luminosity.** Colgate, S.A.; Petschek, A. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 15p. (CONF-7805112—1). Dep. NTIS, MF A01.

From Workshop on supernova and supernova remnants; Sicily, Italy (14 May 1978).

Portions of document are illegible.

The full time-dependent radiation spectrum of a supernova starts when the explosion shock wave reaches the surface of the presupernova envelope. An early radiation spectrum emitted by the expanded and cooling shock-ejected outer layers of an initially compact ($R = 10^{8}$ cm) type I supernova is derived. The relativistically ejected matter is presumably cosmic rays. The Doppler shifted and relativistically time contracted Planck radiation emitted from the expanding surface layers results in an emitted radiation associated with the cooling corresponding to an energy flux of 1.3×10^{43} $t^{-1.05}$ ergs sec^{-1} with a spectrum $I(h\nu)\, dh\nu = 1.5 \times 10^{43} (h\nu)^{-0.92}$ ergs eV^{-1} and time behavior $(h\nu)/\text{sub eff}/ = 108\ t^{-0.61}$ eV. The optical luminosity from the shock is thus low congruent to 10^{40} ergs sec^{-1} and 10^{43} ergs total so that it would not be seen as a precursor to the main optical outburst occurring several days later. The x-ray luminosity (several x 10^{43} ergs in milliseconds) is observable but small compared to extended envelope models. The later optical light curve is then interpreted in terms of radioactive heating, ionization and excitation by 0.2 M/sub solar/ of ^{56}Ni decaying via ^{56}Co to ^{56}Fe. Van Hise (1974) has already pointed out that the two optical decay constants are closely given by the respective radioactive decay constants multiplied by 3/4. This is interpreted as requiring efficiency to produce optical radiation, the Fe^{+} blend, proportional to the (decay rate)/sup 1/3/. It is further noted that when the two optical decay rates are extrapolated to zero time, the intercepts agree with the predicted ratio of deposited energy from $^{56}Ni \rightarrow {}^{56}Co$, and from $^{56}Co \rightarrow {}^{56}Fe$ when the appropriate fractional absorption of gamma rays and beta particles is included. The width and magnitude of the peak luminosity has already been calculated by Colgate and McKee (1969).

6839 (LA-UR—78-2030) **Supernova mass ejection and core hydrodynamics.** Colgate, S.A. (Los Alamos Scientific Lab., NM

(USA)). 1978. Contract W-7405-ENG-36. 20p. (CONF-7805112—2). Dep. NTIS, MF A01.

From Workshop on supernova and supernova remnants; Sicily, Italy (14 May 1978).

Portions of document are illegible.

Simplifications that have emerged in the descriptions of stellar unstable collapse to a neutron star are discussed. The neutral current weak interaction leads to almost complete neutrino trapping in the collapse and to an electron fraction Y/sub e/ congruent to 0.35 in equilibrium with trapped electron neutrinos and "iron" nuclei. A soft equation of state (γ congruent to 1.30) leads to collapse, and bounce occurs on a hard core, $\gamma = 2.5$, at nuclear densities. Neutrino emission is predicted from a photosphere at r congruent to 2×10^7 cm and E/sub ν/ congruent to 10 MeV. The ejection of matter by an elastic core bounce and a subsequent escaping shock is marginal and may not be predicted for accurate values of the equation of state. A new concept of Rayleigh-Taylor driven core instabilities is invoked to predict an increased mass ejection either due to an increased flux and energy of neutrinos at second bounce time and, or, the rapid 0.1 to 0.4 second formation of a more energetically bound neutron star. The instability is caused by highly neutronized external matter from which neutrinos have escaped being supported by lighter matter of the lepton trapped core. An initial anisotropy of 10^{-2} to 10^{-3} should lead to adequately rapid (several milliseconds) overturn following several (2 to 4) bounces. Subsequent to the overturnwith or without a strong ejection shock, a weak ejection shock will allow an accretion shock to form on the "cold" neutron star core due to the reimplosion or rarefaction wave in the weakly ejected matter. The accretion shock forms at low enough mass accumulation rate, $\frac{1}{3}$ M/sub solar/ sec^{-1}, such that a black body neutrino flux can escape from the shock front (kT congruent to 10 MeV, [E/sub ν/] congruent to 30 MeV). This strongly augments the weaker bounce ejection shock by heating the external matter in the mantle by electron neutrino scattering (congruent to 10^{52} ergs) causing adequate mass ejection.

6840 (LA-UR—78-2286) **Nuclear processing during star formation.** Newman, M.J. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 22p. (CONF-7806112—1). Dep. NTIS, PC A02/MF A01.

From 22. astrophysical symposium; Liege, Belgium (20 Jun 1978).

A preliminary survey was conducted of the thermonuclear energy release expected during star formation. The destruction of primordial deuterium provides substantial amounts of energy at surprisingly low temperatures, and must be considered in any meaningful treatment of star formation carried to stages in which the internal temperature exceeds a few hundred thousand degrees. Significant energy generation from consumption of initial lithium requires higher temperatures, of the order of a few million degrees. Depletion of primordial beryllium and boron may never provide an important energy source. The approach to equilibrium of the carbon--nitrogen cycle is dominant at temperatures approaching those characteristic of the central regions of main sequence stars. The present calculation should serve as a useful guide in choosing those nuclear processes to be included in a more detailed study. 8 figures, 2 tables.

6841 **Particle production by black holes.** Hartle, J.B. (Univ. of California, Santa Barbara). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 77-86(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

A black hole will radiate particles quantum mechanically with a thermal spectrum. For spherical black holes of mass M the temperature is given by $kT = nc^3/8\pi GM$. A simple derivation of black hole radiance is given. 3 references.

SOLAR PHENOMENA

6842 (BNL—24629) **Solar neutrino problem.** Davis, R. Jr.; Evans, J.C.; Cleveland, B.T. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 13p. (CONF-780453—11). Dep. NTIS, PC A02/MF A01.

From Neutrinos; West Lafayette, IN, USA (28 Apr 1978).

A summary of the results of the Brookhaven solar neutrino experiment is given and discussed in relation to solar model calculations. A review is given of the merits of various new solar neutrino detectors that were proposed.

6843 (BNL—24673) **^{7}Li—^{7}Be experiment.** Rowley, J.K. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 29p. (CONF-780117—3). Dep. NTIS, PC A03/MF A01.

From Solar neutrino conference; Upton, NY, USA (5 Jan 1978).

An experiment to detect solar neutrinos by use of lithium is considered. The reaction employed is $^7Li(\nu,e^-)^7Be$. The parameters of a possible experimental arrangement are described; chemical separation, backgrounds, and counting are discussed at some length. Despite the problems such an experiment still seems feasible. 5 figures, 6 tables. (RWR)

6844 **Enhancement of solar corona and comet details.** Matuska, W. Jr.; Janney, D.H.; Farrell, J.A.; Keller, C.F. Jr. (Los Alamos Scientific Lab., NM). *SPIE Semin. Proc.;* **119**: 28-35(1977).

Finely detailed striae in astronomical images can be important in formulation of theory. Examples are studies of streamers in the solar corona and of dust tails in comets. In both instances, conventional observations fail to reveal much of the structural detail. Digital image processing has been used at LASL for enhancing these images. The corona images have tremendous variations in film density which must be eliminated before fine striae can be seen. These variations can be removed by means of numerical modeling of their spatial relation to the sun. This model can be thought of as a surface of background film density. In the comet images the overall variation is less severe. Further, the large number of comet images makes it infeasible to model them individually. Hence, an extreme low-pass filter was used to create an image which can be used as the background surface. In both cases, the background surface is divided into the original image pixel-by-pixel. This quotient image is then frequency filtered for edge enhancement or noise control. Nonlinear density transformations are then used to enhance contrast. For both types of images, heretofore unmeasurable details become readily visible for analysis.

GALAXIES

REFER ALSO TO CITATION(S) 6953

COSMOLOGY

6845 **Cosmology and new particles.** Schramm, D.N. (Univ. of Chicago). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 87-101(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

It is shown that the well established, standard Big Bang cosmological model places constraints on some elementary particle properties. In particular, it is shown that only a few additional 2-component zero-mass neutrino species beyond ν/sub e/ and ν/sub u/ are possible before an excessive amount of helium is produced in the Big Bang. It is also shown that if a massive-neutral-stable-lepton were to exist, it might provide the "missing mass" for clusters of galaxies and provide the material for massive halos. Because such a particle would cluster with the galaxies, then such a particle would probably not provide sufficient mass to close the universe. It is shown what constraints astrophysics can place on the allowed masses and lifetimes of an unstable-massive-neutral-lepton. 21 references.

6846 **Causality and symmetry in cosmology and the conformal group.** Segal, I.E. pp 433-447 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

A new theoretic postulate in fundamental physics is considered which is called the chronometric principle because it deals primarily with the nature of time, or its dual or conjugate, energy. Conformality is equivalent to causality. Thus, the group of all local causality-preserving transformations in the vicinity of a point of Minkowski space is, as a local Lie group, identical with the conformal group. The same statement made globally on Minkowski space is: The set of all vector fields on Minkowski space which generate smooth local causality-preserving transformations is identical with the set of all conformal vector fields. The main validation for the chronometric principle is in cosmology or ultramacroscopic physics. Therefore this principle is illustrated along the lines of the red shift. This principle in combination with quantum field theory leads to a convergent and causal description of particle production in which nonlinearities are supplanted by more sophisticated and comprehensive actions for the fundamental symmetry groups. 11 references. (JFP)

PLANETARY PHENOMENA

6847 **Planetary atmospheres with mass spectrometers carried on high-speed probes or satellites.** Nier, A.O. (Univ. of Minnesota, Minneapolis). *Prog. Astronaut. Aeronaut.;* **51**: 1255-1275(1977). (CONF-760710—P2).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

The analysis of complex gas mixtures containing unknown constituents, some of which may be highly reactive chemically or

very low in abundance, poses problems that are difficult to solve, even in the laboratory. For an Earth satellite or a high-speed probe carried to a distant planet, the restrictions on weight, power consumption, and time for analysis, along with other constraints, complicate the problem even further. Properly designed mass spectrometers appear to have the greatest promise for providing the scientific data sought. In the case of the Atmosphere Explorer Satellites C, D, and E, an open-source mass spectrometer of special design has provided successfully, over a large altitude range in Earth's thermosphere, quantitative measurements of atomic nitrogen and oxygen, as well as of the more familiar components, molecular nitrogen and oxygen, argon, and helium. Instruments having some of the same features are carried on the Viking spacecraft for study of the Martian atmosphere during the entry phase of the landings on Mars during the summer of 1976. A closely related instrument also will be carried on the 1978 Pioneer-Venus mission for studying the upper atmosphere of Venus as a probe descends to the planet.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

6848 (CONF-760558—, pp 90-94) **Molecular beam studies of oxide reduction by atomic hydrogen.** Olander, D.R. (Univ. of California, Berkeley). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

The graphite and oxide internals of a CTR are susceptible to chemical corrosion as well as to physical degradation by high-energy particles. Reactions of thermal atomic hydrogen with oxides are being studied. The hydrogen used is at thermal energy (0.22 eV). Typical data are reported for the H/UO_2 system. The reaction probability is plotted as a function of solid temperature at fixed beam intensity and moculation frequency. The reaction probability increases from low temperature to a high-temperature plateau at about 1300°C. Here the reaction rate is limited solely by the sticking probability of H on the surface; about one in seven of the incident atoms is chemisorbed by the surface and ultimately returns to the gas phase as water vapor. A reaction model comprising sticking, recombination to H_2, solution and diffusion of H in the bulk of the UO_2, surface reaction of adsorbed H with lattice oxygen atoms to produce the hydroxyl radical, and production of water is constructed. The rate constants for the elementary steps in the mechanism are tabulated. 2 figures, 2 tables. (RWR)

6849 **Infared studies of binding and structure in monobasic organophosphorus acids and their salts.** Katzin, L.I.; Mason, G.W.; Peppard, D.F. (Argonne National Lab., IL). *Spectrochim. Acta, Part A;* **34A**: 51-56(1978).

The P=O vibrations of a number of monobasic acids, which are alkyl and aryl derivatives of P(V), are followed through a series of their salts. Trends are pointed out, and relations to crystal bonding, including possible resonance equivalence of the phosphoryl oxygens, are discussed. Certain acids are reported in which no P=O absorption band has been detected. The relation of this phenomenon to crystal structure, phosphoryl base strength, and oxygen resonance is discussed. Some unusual characteristics of cations in the salts are also pointed out.

6850 **Infrared spectal observation on the P=O group vibration of some homogeneous series of organic derivatives of P (V).** Katzin, L.I.; Mason, G.W.; Peppard, D.F. (Argonne National Lab., IL). *Spectrochim. Acta, Part A;* **34A**: 57-61(1978).

Wave numbers for i.r. frequencies of P=O vibrations in complete series of neutral organic derivatives of phosphoric acid for groups n-butyl, 2-ethylhexyl, n-octyl and phenyl are presented, together with values for the diester acids, phosphonic acid half-esters and phosphinic acids. These data have been used to evaluate generalizations relating group electronegativity and P=O frequency. There is no direct correlation between pK and P=O frequency.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 6297

6851 **Orientation of fast ions excited in surface collisions.** Berry, H.G.; Gabrielse, G.; Livingston, A.E. (Univ. of Chicago). *Nucl. Instrum. Methods;* **149**: 517-522(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

The grazing angle scattering of fast heavy ions (He, Ne and Ar at 0.05 to 3.0 MeV) from copper and gold surfaces was investigated by (a) measuring the angular distribution of the scattered ion distribution and (b) observing the states of polarization of light emitted from excited states of the scattered ions. The ion distributions disagree significantly with those calculated by Firsov, but agree with previous lower velocity measurements. The polarization is strongly dependent on the angle of scattering and evidence is given that the atomic orientation depends principally upon the exit grazing angle. We discuss the surface collision mechanisms.

6852 **Annealing behavior of dysprosium ion implanted nickel: a combined study using Rutherford backscattering, transmission electron microscopy, and total curent spectroscopy.** Chadderton, L.T. (Univ., Copenhagen); Johnson, E.; Komolov, S.A. *Nucl. Instrum. Methods;* **149**: 639-645(1978). (CONF-770642—).

From 3. international conference on ion beam analysis; Washington, DC, USA (27 Jun 1977).

Experiments are described in which a combined RBS and TEM study of the annealing of nickel, rendered amorphous by implantation of 20 keV dysprosium ions is supplemented with a completely new technique—total current spectroscopy (TCS). In TCS low energy electrons (0 to 15 eV) are used to probe the damaged nickel. Observations have been made during annealing of both the reappearance of the bulk band structure of the metal and of a "surface peak" which is highly sensitive to the recovery process. Changes in the height of the surface peak reveal three sharp annealing stages, the first two being preceded by reverse annealing which correlates well with RBS and TEM results. The first annealing stage—following the amorphous to crystalline transition—may be associated with electronic effects in the vicinity of the Curie point. Changes in the position of the surface peak allow one to trace the diffusion of dysprosium to the surface. Quantum-mechanical resonances at the damage/crystal interface have also been followed throughout annealing. The initially amorphous layer (approximately 2.2 nm) increases in thickness slightly during recovery. A much fuller picture of the complicated solid state annealing process taking place is obtained if the three techniques are used together. In the case of dysprosium-implanted nickel, TCS appears to give a more accurate measure both of the annealing stages and the layer thickness than does RBS.

6853 **Mass dependent molecular beam focusing by cross-jet deflection.** Gspann, J.; Vollmar, H. (Univ., Karlsruhe, Ger.). *Prog. Astronaut. Aeronaut.;* **51**: 123-134(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

The mass-dependent gradual deflection of heavy molecular beam particles effected by multiple collisions with lighter molecules of intersecting free jets leads to spatial separation of different heavy species. With nonvanishing molecular beam width or angular divergence, optimum separation is expected for regions where the average particle trajectories of a certain species are focused. Two reasons may cause average trajectory focusing: (1) Initially parallel trajectories finally may intersect because they traverse regions of different integral cross-jet flow. For axisymmetric cross-jets, this is shown by calculated average trajectories and verified experimentally with xenon atomic beams deflected by hydrogen cross-jets and helium cluster beams deflected by xenon cross-jets. (2) Trajectories with different initial inclination against the cross-jet flow are deflected differently. This leads to average trajectory focusing for initially divergent beams intersecting two-dimensional cross-jets, a series of which causes nearly perfect focusing on essentially circular orbits.

6854 **Time-of-flight studies of argon beams scattered from a silver (111) crystal surface.** Jih, C.T.R.; Hurlbut, F.C. (Univ. of California, Berkeley). *Prog. Astronaut. Aeronaut.;* **51**: 539-553(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

Monoenergetic nozzle beams of argon atoms at energies of 0.06 to 0.1 eV were scattered from the (111) plane of a silver single crystal. The density, drift velocity, and translational temperature of the scattered atoms were determined from time-of-flight measurements for numerous combinations of surface temperature, beam energy, and the angular parameters. A systematic transformation of the angular distributions of drift velocity with increasing beam energy was observed. The earliest onset of this transformation occurred in the present system at an incident energy of 0.5 eV with more definitive patterns recorded at Ei = 0.81 eV. Typically, the scattered drift velocity increased with increasing angle of scattering, then dropped through the region of the scattered density maximum before continuing the rising trend. It is suggested that the deeper penetration of the surface lattice repulsive potential field by incident atoms results in energy extractive collisions within a short span of interactive parameters close to the uppermost portions of the lattice atoms.

6855 **Extremal scattering of molecular hydrogen from (001) MgO.** Rathbun, L.; Ehrlich, G. (Univ. of Illinois, Urbana). *Prog. Astronaut. Aeronaut.;* **51**: 555-564(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

In the scattering of molecules from a crystal, the internal degrees of freedom ot the molecules may participate to a significant extent. We report on diffraction of H_2, D_2 and HD from (001) planes of MgO, prepared by cleavage in ultrahigh vacuum. For these molecules, the interchange of rotational and translational energy occurs with high efficiency in coherent scattering, without imparting energy to the lattice. In rotationally inelastic diffraction, the scattering angle may show an extremum as a function of the incident wavelength. For in-plane scattering of a beam with a thermal distribution of velocities, singularities then develop in the differential scattering amplitude. The expected shape of rotational diffraction peaks is calculated and compared with experiment for H_2, D_2 and HD beams incident along the [110] azimuth of (001) MgO. The ability to detect rotationally inelastic transitions is shown to be affected strongly by extremal scattering.

6856 Scattering of molecular beams on the polycrystalline nickel surface. Fujimoto, T.; Furuya, Y.; Hayashi, T.; Takigawa, H. (Nagoya Univ., Japan). *Prog. Astronaut. Aeronaut.;* **51**: 565-574(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

Using the high-intensity molecular beam method, the scattering of argon and nitrogen molecules on the polycrystalline nickel surface of various temperatures was studied experimentally. When the surface temperature is varied according to a schedule, some variation of scattering characteristics was observed. When the target is heated and cooled gradually in the range lower than 600°C, the transition from diffuse scattering to weak lobular scattering takes place, depending on the manner in which the temperature is varied. If the surface is heated once beyond 600°C, strong lobular scatterings, which are reproducible independent of the surface temperature increase or decrease, are observed. The Nocilla wall reflection model was selected to compare experimental results with the theory.

6857 Elastic scattering of helium from (100) copper. Lapujoulade, J.; Armand, G.; Lejay, Y. (CEN de Saclay, Gif-sur-Yvette, France). *Prog. Astronaut. Aeronaut.;* **51**: 575-587(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

The scattering of helium from (100) copper has been studied with a high angular (0.25°) and velocity resolution. Under these conditions, the elastic component of the specular peak is distinguished from the inelastic one. The elastic peak behaves like a Bragg's diffraction peak; its amplitude is described correctly by a Debye-Waller factor analysis. The magnitude of this factor is lower than in the Leed experiment. This may be explained if the helium atom is supposed to interact with a square cell of four surface atoms. The apparent surface Debye temperature, calculated with this model, is in good agreement with the experimental results.

6858 Two-phonon contributions to the energy accommodation coefficient. Manson, J.R.; Tompkins, J. (Clemson Univ., SC). *Prog. Astronaut. Aeronaut.;* **51**: 603-619(1977). (CONF-760710—P1).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

The theory of multiple-phonon surface scattering of neutral atoms is developed in the first- and second-order Distorted-Wave Born Approximation (DWBA). Calculations are carried out for the thermal accommodation of helium at a tungsten surface. We find that the contribution due to the first DWBA is negligible even for temperatures as high as 400°K. The second DWBA, on the other hand, gives significant contributions to the accommodation for temperatures greater than 100°K and gives a much better agreement with experiment than theories that permit only a single phonon exchange.

6859 Slowing down of fast atoms in a uniform gas. Williams, M.M.R. (Univ. of London). *Prog. Astronaut. Aeronaut.;* **51**: 679-694(1977). (CONF-760710—P2).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

The nonlinear Boltzmann equation is modified to describe the slowing down of fast particles, i.e., those with energies very much greater than thermal values. Two situations are discussed: (1) the foreign gas, in which fast alien particles are followed after their injection into the host; and (2) the single gas, in which a fast disturbance in the host is examined as the particles in it share their energies by generating recoils. Using a scattering cross section derived from a modified inverse power law of interaction, we obtain exact solutions by Mellin transforms of the time-energy evolution of the particles. The mean energy dissipation rate, the average number of recoils generated, and the slowing-down times are studied for a variety of scattering models. It is concluded that, in general, the slowing-down time of particles in the single gas is longer than those of the foreign gas, when scaled in units of the mean free time at source energy. We also find that, for a given total cross section energy variation, as the scattering becomes more anisotropic in the center-of-mass system, the particles of the foreign gas take longer to slow down, whereas those in the single gas take a shorter time. An explanation of this anomalous behavior is advanced.

6860 Relaxation of hot atoms with chemical reaction. Koura, K. (National Aerospace Lab., Tokyo). *Prog. Astronaut. Aeronaut.;* **51**: 949-956(1977). (CONF-760710—P2).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

The relaxation of the hot-atom velocity distribution in the hot-atom reaction is studied by solving the Boltzmann equation with the Monte Carlo simulation. The explicit time-dependent hot-atom velocity distribution, temperature, and rate constant from initial to steady states are obtained for a simple model system corresponding to the F-H_2 system with the hot-atom reaction $F + H_2 \rightarrow HF + H$, where hot atoms are dispersed in the heat bath of surrounding molecules without internal degrees of freedom and the cross sections are chosen as a simple hard-sphere model. The high-temperature steady state (HTS), where the hot-atom velocity distribution is different from the Maxwell distribution, exists for the ratio of reactive to elastic cross sections sigma/sub r//sigma/sub e/ approximately > 5 in consistence with the prediction of Keizer with the Maxwell distribution approximation, which indicates that HTS may not exist for the F-H_2 system with sigma/sub r//sigma/sub e/ similarly ordered 2 at HTS.

6861 Production of helium nozzle beams with very high speed ratios. Brusdeylins, G.; Meyer, H.D.; Toennies, J.P.; Winkelmann, K. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Ger.). *Prog. Astronaut. Aeronaut.;* **51**: 1047-1059(1977). (CONF-760710—P2).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

Earlier measurements of large speed ratios in He have been extended to speed ratios of 225 in a new, improved apparatus with greater time-of-flight resolving power. The high resolution has made it possible to observe significant deviations in the velocity distribution from the simple Maxwellian form observed in previous work. The speed ratios evaluated assuming a single Maxwellian have been found to be in good agreement with a moments solution of the Boltzmann equation in which a Maxwellian form also is assumed. This simplified theory and the observed deviation in the velocity distribution are both in reasonable agreement with a recent Monte Carlo simulation calculation by Chatwani under otherwise identical conditions. These new results demonstrate that temperatures as low as 8.4×10^{-3} °K and beams with velocity spreads (FWHM) as low as 0.7% can be achieved. The theory suggests that temperatures as low as 2×10^{-3} °K and relative velocity spreads as low as 0.275% should be achievable with our apparatus.

6862 Studies of laser-generated atomic beams and metal-oxide chemiluminescent reactions. Tang, S.P.; Friichtenicht, J.F. (TRW Defense and Space Systems Group, Redondo Beach, CA). *Prog. Astronaut. Aeronaut.;* **51**: 1061-1074(1977). (CONF-760710—P2).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

The velocity distribution of atoms within atomic beam pulses produced by the rapid vaporization of thin metallic films with a pulsed laser have been measured as a function of laser bombardment conditions and the angle of observation. The results show that the average energy of the atoms is a function of the laser beam energy density and the angle of observation as referenced from the normal to the thin-film target. Measurements of the integrated beam flux show that the metallic vapor forms a narrow plume centered about the normal to the target. The velocity distributions of both atomic species form Al-Sn alloy targets are consistent with a Maxwellian distribution superimposed on a center-of-mass motion of the vapor cloud as a whole. However, analysis indicates that the two species equilibrate at different temperatures. Chemiluminescence resulting from metal-oxide formation reactions has been observed.

6863 Isotope effect on the formation of hydrogen cluster beams. Obert, W. (Kernforschungszentrum, Karlsruhe, Ger.). *Prog. Astronaut. Aeronaut.;* **51**: 1153-1162(1977). (CONF-760710—P2).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

Experiments with cluster beams formed by the hydrogen isotopes H_2 and D_2 show considerable differences in cluster size and intensity. It is found that, in spite of the marked differences in the thermodynamic properties of both isotopes, under identical stagnation conditions, the cluster size is nearly equal for both isotopes at 30°K nozzle temperature. At 77°K nozzle temperature, the H_2 clusters are about twice, and at 110°K about 2.5 times as large as that of D_2; however, the vapor pressure of D_2 is smaller than that of H_2, and therefore larger D_2 clusters would be expected. On the basis of the well-known marked differences in the thermodynamic properties of the two isotopes that control the clustering process, the

differences in cluster size and intensity are discussed. It is shown that the pronounced isotope effect in vapor pressure will be nearly compensated for by the effect in molar volume and condensation energy. The differences resulting from the variation of the nozzle temperature are explained by the differences caused by quantum mechanics in the number of excited rotational energy terms of the two isotopes. The number of these terms determines the specific heat, and thus the curve for the adiabatic expansion of both gases. Accordingly, it is possible to discuss cluster beam formation in the case of the ortho- and paramodification of hydrogen, just as in the case of tritium.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 6251, 6944

6864 (COO—3403-13) **Anisotropic intermolecular interactions and rotational ordering in hydrogen containing solids. Final report, January 1, 1972—June 30, 1978.** White, D. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1978. Contract EY-76-S-02-3403. 138p. Dep. NTIS, PC A07/MF A01.

Thermodynamic properties, order-disorder phenomena, optical, electric and magnetic properties of hydrogen-containing molecular solids have been investigated. A summary of the findings of this 6 year research program is presented here. The approach in these studies was (a) thermodynamic and transport studies extending to very low temperatures, (b) pulsed NMR studies for determination of structural parameters important to spin-lattice relaxation, and (c) pulsed laser studies for the investigation of excitations and energy transfer mechanisms in solids. (GHT)

6865 **Further progress in systematics of free diatomic-molecule electronic-transition intensity constants.** Hefferlin, R. (Oak Ridge National Lab., TN). *J. Quant. Spectrosc. Radiat. Transfer;* **19**: 335-338(1978).

Literature absolute intensity constants were compiled and critically assessed for A--X and related (0,0) molecular bands. Shown plotted for isovalent sequences, they indicate, as do earlier results, that simple and useful trends exist.

6866 **Q-branch spectrum of the (01/sup 1d/0—00°0) transition of $^{13}C^{16}O_2$.** Reisfeld, M.J.; Flicker, M. (Los Alamos Scientific Lab., NM). *J. Mol. Spectrosc.;* **69**: 330-332(1978).

The Q branch of the $^{13}C^{16}O_2$(01/sup 1d/0-00°0) band at 648.48 cm^{-1} was measured by means of laser diode spectroscopy. The positions of lines Q(2) through Q(28) were measured with an estimated accuracy of +- 0.001 cm^{-1}. A sample spectrum covering Q(2) to Q(16) is shown with the individual Q(J) lines clearly resolved. To first order, the spacing between consecutive lines within the Q branch is given by $\Delta \text{ anti } \nu = Q(J+2) - Q(J) = 4\Delta B(J + 3/2)$ + ... (1). A one-parameter least-squares fit of the intervals as a function of J yielded a value of ΔB for the (01¹00-00°0) transition in $^{13}C^{16}O_2$ of 1.0039 +- 0.0026 X $10^{-3} cm^{-1}$. A plot of the residuals between observed and calculated intervals is shown. The values for the wave numbers of the Q(J) lines are shown. Utilized as a wave number marker was the position of the P(24) line of the (01/sup 1c/0-00°0) transition in $^{12}C^{16}O_2$ which lies between Q(18) and Q(20) for $^{13}C^{16}O_2$.

6867 **Double resonance spectroscopy of multiple-photon excited molecules.** Steinfeld, J.I.; Melzer, J.E. (Massachusetts Inst. of Tech., Cambridge). *SPIE Semin. Proc.;* **113**: 109-113(1977).

Multiple infrared photon absorption is a quite general process which molecules can undergo when placed in a high flux of infrared energy, such as the focussed beam of a CO_2 laser. Among the important consequences of this kind of absorption are isotopically selective molecular dissociation and stimulation of specific chemical reactions. In order to understand how this process works, one must be able to follow the evolution of the molecules through their internal states, populated by photon absorption. Double resonance spectroscopy is the method of a choice for getting at this information. A system pumped by CO_2 laser radiation can be examined with a tunable laser probe beam, such as that from a lead-salt diode laser. From such an experiment, Rabi modulation of the absorption lines can be directly observed, elementary state-to-state relaxation pathways determined, and higher excited vibrational states located. Systems currently under investigation include SF_6 and vinyl chloride. In suitable cases, the probe beam can be a tunable visible or u.v. source, such as a dye laser. Fluorescence spectroscopy can then be used to monitor the transient absorptions produced by multiple-photon excitation. Among the systems which can be examined in this way are biacetyl and glyoxal.

6868 **Use of the SO(4,2) dynamical group for the study of the ground state of a hydrogen atom in a homogeneous magnetic field.** Cizek, J.; Vrscay, E.R. pp 155-160 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

A perturbation procedure based on the use of the SO(4,2) dynamical group, which includes as its most important feature the nonunitary tilting transformation, is applied to the hydrogen atom system in a strong magnetic field and the terms $\Delta\Sigma$/sub n/ were calculated to 40th order. The difficulty in using this approach is that the series has zero radius of convergence. Nevertheless, the Pade approximant technique may be used for the summation of the series. Surprising accuracy is found for the Pade estimate of the ionization energy. 5 references. (JFP)

6869 **Group O(3)/sub Λ/T_2 x anti T_2) and the hydrogen atom.** Yadegar, J. pp 203-210 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The group 0(3) LAMBDA (T_2 x anti T_2) in which the generators additional to those of 0(3) form a reducible tensor representation of 0(3), [T(1/3 +- 1/3), anti T(1/3 +- 1/3)] is considered. The states correspond to Stark or parabolic states of the hydrogen atom. 36 references. (JFP)

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 6862

6870 (CONF-780734—2) **Electron scattering cross sections pertinent to electron microscopy.** Inokuti, M. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

From Workshop on analytical electron microscopy; Ithaca, NY, USA (24 Jul 1978).

Some elements of the physics that determine cross sections are discussed, and various sources of data are indicated that should be useful for analytical microscopy. Atoms, molecules, and to some extent, solids are considered. Inelastic and elastic scattering of electrons and some solid-state effects are treated. 30 references. (JFP)

6871 (CONF-780931—1) **Ion-molecule collision complexes.** Klots, C.E. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 15p. Dep. NTIS, MF A01.

From NATO institute on ion-molecule reactions; La Boule, France (4 Sep 1978).

Portions of document are illegible.

A summary of ideas emerging at the workshop on ion-molecule collision complexes is given and covers the direct observation of colision complexes, unimolecular reactions of collision complexes, and the direct preparation of collision complexes. 31 references. (JFP)

6872 **Potential energy surfaces for fluorine—hydrogen systems.** Bender, C.F. (Univ. of California, Livermore); Schaefer, H.F. III. *ACS Symp. Ser.;* No. 66, 283-295(1978).

Ab initio molecular electronic structure theory has now progressed to the point where it is capable of making genuine contributions to the understanding of simple chemical reactions. Especially noteworthy examples are the elementary fluorine hydrogen reactions pertinent to the HF chemical laser. The reactions $F + H_2 \rightarrow FH + H$, $H + FH \rightarrow HF + H$, $H + F_2 \rightarrow HF + H$, and $F + HF \rightarrow FH + F$ are discussed, with particular emphasis on the relationships between ab initio theory and experiment. Directions for future research are suggested.

6873 **Alternating direction method for Schroedinger's equation.** Dendy, J.E. Jr. (Los Alamos Scientific Lab., NM). *SIAM J. Numer. Anal.;* **14**: No. 6, 1028-1032(Dec 1977).

It is shown that an A.D.I. scheme is applicable to the time-dependence Schrodinger equation and yields an error estimate of $O(\Delta t)^2 + h^2)$. The method is also applicable to time-dependent vibration problems provided that the boundary conditions can be properly treated.

6874 **Multiple infrared photon dissociation of vinyl chloride.** Lussier, F.M.; Steinfeld, J.I. (Massachusetts Inst. of Tech., Cambridge). *Chem. Phys. Lett.;* **50**: No. 2, 175-180(1 Sep 1977).

Dehydrohalogenation of vinyl chloride, to form acetylene and HCl, is produced by irradiation with infrared laser pulses in the 9 to 11 μm region. The acetylene itself is broken down to yield diacetylene and elemental carbon and hydrogen when irradiated by focused laser pulses. Initial excitation into vibrational modes of different symmetry appears to be about equally effective in converting absorbed energy to chemical reaction. The results are analyzed in terms of several models for multiple infrared photon dissociation; threshold energies of 20 to 50 J/cm^2 are deduced.

6875 Electron-capture and impact-ionisation cross sections of N/sup q/$^+$ in atomic hydrogen. Phaneuf, R.A.; Meyer, F.W.; McKnight, R.H.; Olson, R.E.; Salop, A. (Oak Ridge National Lab., TN). *J. Phys., B (London);* **10**: No. 11, L425-L428(1977).

Cross sections for electron capture by N/sup q+/ ($1 \leq q \leq 5$) incident on atomic hydrogen have been measured in the velocity range (0.3 to 5.2) x 10^8 cm s^{-1}. A classical trajectory Monte-Carlo method was used to calculate the electron-capture and impact-ionisation cross sections for incident-ion charge states $3 \leq q \leq 7$. The experimental and theoretical electron-capture cross sections are in good agreement and are found to scale as q^2/sub eff/, where q/sub eff/ may be obtained from spectroscopic energy levels. The impact-ionisation cross sections rise to a maximum around v = 4–6 x 10^8 cm s^{-1}, above which impact ionisation dominates electron capture as the principal H electron-loss process.

6876 Experimental components of a crossed molecular beam apparatus designed to study the reaction O + H_2O = OH + OH. Poulsen, P.; Miller, D.R.; Fineman, M.A. (Univ. of California, San Diego, La Jolla, CA). *Prog. Astronaut. Aeronaut.;* **51**: 1091-1099(1977). (CONF-760710—P2).

From 10. international symposium on rarefied gas dynamics; Aspen, CO, USA (18 Jul 1976).

The components of a crossed molecular beam apparatus to study the reaction O + H_2O = OH + OH have been completed and tested. With ground state O(^{3}P) the reaction is endoergic by approximately 0.75 eV, requiring accelerated beams of O(^{3}P) and H_2O. A microwave discharge source utilizes helium-oxygen mixtures (95% He) at high pressures (50 Torr) to give good dissociation (70%) and fast atomic oxygen (approximately 0.3 eV). The effects of microwave power and source composition on conversion are reported. The required water beam source is an electron beam heated iridium nozzle operated with a 95% He/5% H_2O mixture at 1750°K and approximately 2200 Torr to provide H_2O beam energies approximately 1.25 eV. Mass spectrometer detection of the OH radical is accomplished by replacing the conventional ionization source on a quadrupole mass spectrometer by a barium chemi-ionization source. The ionization reaction OH + Ba → $BaOH^+$ + e is selective at thermal energies, not occurring with O, O_2, or H_2O.

6877 Studies of multiphoton dissociation of polyatomic molecules with crossed laser and molecular beams. Grant, E.R.; Coggiola, M.J.; Lee, Y.T.; Schulz, P.A.; Sudbo, A.S.; Shen, Y.R. (Univ. of California, Berkeley). *ACS Symp. Ser.;* No. 56, 72-82(1977).

It is shown that crossed laser and molecular beam studies of collisionless multiphoton dissociation of polyatomic molecules have led to a much better understanding of the dynamics of excitation and dissociation of this important isotopically selective process.

ATOMIC AND MOLECULAR THEORY

REFER ALSO TO CITATION(S) 6901, 6953

6878 Analytic approximations in multi-level excitation theory. Shore, B.W. (Univ. of California, Livermore); Eberly, J.H. *Opt. Commun.;* **24**: No. 1, 83-88(Jan 1978).

Applicability of simple single-term analytic approximation formulas, based upon infinite-level excitation sequences, to the description of time-dependent populations of resonantly excited N-level atoms or molecules is discussed.

FLUID PHYSICS

6879 (METC/CR—78/9) **Formation of bubbles in gas particulate fluidized beds.** Fanucci, J.B.; Ness, N.; Yen, R.H. (West Virginia Univ., Morgantown (USA). Dept. of Aerospace Engineering). Jul 1978. Contract EY-77-C-21-8087. 91p. Dep. NTIS, PC A05/MF A01.

The method of characteristics is applied to the nonlinear equations describing two phase flow. The method shows how a small disturbance changes with time and distance and can, eventually, produce a flow discontinuity similar to a shock wave in gases. The parameters entering the analysis are the amplitude of the initial disturbance, the wave length of the original disturbance, the particulate pressure function, the particulate size, the uniform fluidization voidage, the uniform fluidization velocity, the fluid viscosity, the particulate density, and the fluid density. A study of the parameters indicates a qualitative agreement with experimental data for gas-particulate fluidized beds. It is shown theoretically, and these results have been confirmed experimentally, that the following factors increase bed stability: a decrease in the particulate size, an increase in the bed density, an increase in the fluid viscosity, and a decrease in the particulate density. This theory is the first to show rigorously that a small disturbance can lead to a particulate shock wave which may indicate the creation of a bubble. 18 figs, 2 tables. (RWR)

GENERAL FLUID DYNAMICS

6880 (DOE/NASA—7405-78/1) **Mathematical and computational studies of equilibrium capillary free surfaces.** Albright, N.; Chen, N.F.; Concus, P.; Finn, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1977. Contract W-7405-ENG-48. 176p. (NASA-CR—135345). Dep. NTIS, PC A09/MF A01.

The results of several independent studies are presented. In the first, the general question is considered of whether a wetting liquid always rises higher in a small capillary tube than in a larger one, when both are dipped vertically into an infinite reservoir. It is proved, by example, that the answer in some cases is negative. In the second study, an analytical investigation is initiated to determine the qualitative behavior of the family of solutions of the equilibrium capillary free-surface equation that corresponds to rotationally symmetric pendent liquid drops and the relationship of these solutions to the singular solution, which corresponds to an infinite spike of liquid extending downward to infinity. The next two studies are computational ones. In the first, the block successive overrelaxation-Newton method and the generalized conjugate gradient method are investigated for solving the capillary equation on a uniform square mesh in a square domain, including the case for which the solution is unbounded at the corners. In the second, capillary surfaces are calculated on the ellipse, on a circle with re-entrant notches, and on other irregularly shaped domains by using JASON, a general-purpose program for solving nonlinear elliptic equations on a nonuniform quadrilateral mesh. In the last study, analytical estimates for the nonexistence of solutions of the equilibrium capillary free-surface equation on the ellipse in zero gravity are evaluated. Each of these five studies has already been published, in an open journal or as an LBL report.

6881 (LA—7432-MS) **Shear-layer instability in cylindrical implosions of rotating fluids.** Mjolsness, R.C.; Ruppel, H.M. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 20p. Dep. NTIS, PC A02/MF A01.

One-dimensional implosions of a fluid in differential rotation and containing a steep shear layer have been studied numerically using an angular momentum conserving code. Some of the details of the code are presented. It is found that after the passage of the first radial shock, the pressure and velocity profiles oscillate about a power law close to that of a self-similar solution. The traveling oscillations are produced by the dynamics of a series of radial shocks. An approximate stability theory for the shear-layer instability is given for this geometry. It is found that growth rates increase very strongly as the implosion proceeds and that the details of the velocity profiles influence both the most unstable mode number and the absolute growth rate.

6882 (UCID—17046(Rev.1)(Add.1)) **Hydrodynamic equations of state for the KOVEC code.** Steinberg, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Aug 1978. Contract W-7405-ENG-48. 4p. Dep. NTIS, PC A02/MF A01.

Since major revisions of the KOVEC equation of state file have become so cumbersome that they cannot be easily done in a reasonable time period, brief addenda covering recent developments are now issued. (GHT)

PROPERTIES AND STRUCTURE OF FLUIDS

REFER ALSO TO CITATION(S) 6251

6883 (LA—7264-MS) **User's manual for SIN: a one-dimensional hydrodynamic code for problems that include chemical reactions, elastic—plastic flow, spalling, phase transitions, melting, Forest Fire, detonation build-up, and Sesame tabular equation of state.** Mader, C.L.; Shaw, M.S. (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract W-7405-ENG-36. 129p. Dep. NTIS, MF A01.

Portions of document are illegible.

A CDC 7600 or CRAY computer FORTRAN code for computing one-dimensional hydrodynamic problems in slab, cylindrical, or spherical geometry with realistic equations of state is described. Features available in the code include chemical reactions using an Arrhenius rate law, the C-J volume burn, or, for slabs, a gamma-law Taylor wave; sharp-shock burn, Forest Fire; elastic—plastic flow using the Hooke's law—Von Mises yield model and Kennedy melt law; and spalling using the Whiteman and Skidmore model of the tensile stress at spalling as a linear function of the square root of the stress rate. The HOM equation of state is used to compute the equation of state for detonation products, undecomposed explosives, mixtures of the two, and condensed components which may have an instantaneous phase change. The Sesame tabular equation of state, Barnes equation of state, explosive build-up equation of state, and a solid-foam equation of state are included. Sample

input and output are given for several typical types of problems. 2 tables.

6884 (UCRL—52444) **CHAMP: a Coupled HEMP and Multifluid Eulerian Program for fluid flow simulations.** Edwards, L.L.; Hickman, R.B.; Hobson, J.K.; Michels, T.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1978. Contract W-7405-ENG-48. 61p. Dep. NTIS, PC A04/MF A01.

The CHAMP (Coupled HEMP and Multifluid Eulerian Program) computer code package solves complex fluid flow simulations in which multiple Eulerian and Lagrangian spatial frames may be used simultaneously in a single computation. A splitting of operators allows a computational pass to compute thermal diffusion. This report discusses finite difference methods, Eulerian—Lagrangian coupling, and interface equations as well as the code package and logic flow paths. Sample calculations of illustrative check problems are included. 48 figures.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

6885 (COO—3539-10) **Experimental investigations in particle physics at intermediate energies. Progress report, December 1, 1977—November 30, 1978.** Auerbach, L.B.; Highland, V.L.; McFarlane, W.K. (Temple Univ., Philadelphia, PA (USA). Dept. of Physics). Aug 1978. Contract EY-76-S-02-3539. 12p. Dep. NTIS, PC A02/MF A01.

During this period data taking on the second run at LAMPF to search for the three gamma decay mode of the neutral pion will be completed. The proton-antiproton bound states experiment at the Brookhaven AGS will also begin running, with UNM and UC (Irvine). Analysis of the first pi-zero to three gamma experiment is complete and the result published; a four-gamma upper limit was also found. Data-taking on the proton-antiproton experiment with Rutgers and BNL is complete; analysis is in progress. The analysis of the nucleon—nucleon experiments in collaboration with UNM and LASL is nearly complete with the np elastic differential cross-section accepted for publication. It is expected to complete the remainder of the analysis of the 800 MeV data in the next few months.

6886 (TID—28814) **High energy physics study. Final report.** Schultz, J. (California Univ., Irvine (USA). Dept. of Physics). 1978. Contract EY-76-S-03-0034-149. 16p. Dep. NTIS, PC A02/MF A01.

A final report is presented on the activities of Task B of the Experimental High Energy Physics Group at the University of California, Irvine. The report deals primarily with a description of and results from the Task B group's major project, the DELCO experiment at the Stanford Linear Accelerator Center. This experiment consisted of a study of direct electrons produced in e^+e^- collisions at SPEAR. Also discussed are two other experiments engaged in by this group: a study of particular final states produced by long-lived neutral kaons in hydrogen, and a search for massive muon pairs produced by K°/sub L/ on a copper target. A list of publications is included.

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 6917

6887 (COO—1545-235) **Higgs scalar in vector meson decays.** Frampton, P.H.; Wada, W.W. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1978. Contract EY-76-C-02-1545. 11p. Dep. NTIS, PC A02/MF A01.

For the (anti tt) bound-state which is designated T, expected to be discovered shortly, the leptonic and hadronic decay widths, and the production cross section in e^+e^- annihilation are studied. For both Y(9.5,anti bb) and T, the decay into Higgs scalar plus photon is calculated, employing a triangle diagram estimate for the dependence of this decay matrix element on the Higgs mass. Provided that the Higgs mass is less than the masses of the vector mesons, the decay should be observable.

6888 **Exclusive and inclusive final states in deep inelastic lepton scattering.** Cassel, D.G. (Cornell Univ., Ithaca, NY). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 297-337(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Recent experiments yield sybstantially improved data describing the hadronic final states in deep inelastic e and μ scattering. The inclusive data from these experiments invite a detailed comparison with the quark fragmentation picture of inelastic lepton scattering. New vector meson electroproduction data are also presented. 38 references.

6889 **Photoproduction at high energies.** Eisner, A.M. (Univ. of California, Santa Barbara). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 355-373(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Total photoproduction cross sections from hydrogen and nuclei at energies above 4 GeV are reviewed, and the recent Fermilab experiment described in some detail. Hydrogen data show a rising total cross section at Fermilab energies, and suggest that its magnitude may not be accounted for by vector dominance models without charm. Recent results on shadowing in heavy nuclei (from Cornell and Serpukhov, plus very preliminary Fermilab data) are presented, and the overall experimental situation summarized. 26 references.

6890 **Results on e^+e^- annihilation studies at DORIS.** Meyer, H. (Univ. of Wuppertal, Ger.). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 413-440(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

The results presented on e^+e^- annihilation include the total cross sections, inclusive particle production of various hadrons for example psi, rho, and the discovery of F and F* mesons, and the anomalous lepton signals showing tau particle production and decay for which various branching ratios are shown. 33 references. (JFP)

6891 **Anomalous electron production using the lead glass wall at SPEAR.** Lecomte, P. (Lawrence Berkeley Lab., CA). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 457-466(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Recent results from SPEAR on anomalous electron production in electron-positron annihilation are presented. The data were collected with the Mark I Magnetic Detector, supplemented by an array of lead glass counters. Two charged prong events as well as multi-prong events, both with an electron detected in the lead glass wall, are discussed. The two-prong data are compared with predictions resulting from the heavy lepton hypothesis and the branching ratios Br(tau$^-$ → e$^-$ anti nu/sub e/nu/sub tau/) as well as Br(tau → charged hadron + neutrals) are evaluated. The multiprongs data are used to obtain the branching ratio for the decay of the D meson into electron. 11 references.

6892 **Review of heavy leptons in e^+e^- annihilation.** Fluegge, G. (Deutsches Elekronen-Synchrotron, Hamburg). pp 132-159 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

A review is given of the existing evidence for the production of a pair of new heavy leptons in e^+e^- annihilation. The new phenomenon was detected in four different experiments. Data are in good agreement with the assumption, that a sequential heavy lepton tau of mass 1.9 +- .1 GeV/c^2 is produced in e^+e^- collisions. 28 references.

6893 **Review of meson resonance radiative decays.** Thorndike, E.H. (Univ. of Rochester, NY). pp 354-366 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

The radiative decays of meson resonances can be studied by three different approaches, it is noted. These are the meson-exchange, Primakoff effect, and the production of the desired resonance and subsequent observation of its decay. These approaches are criticized and examples of them are reviewed. Mass distributions are shown and branching ratios discussed. 21 references. (JFP)

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 6887, 6888, 6890, 6892, 6947, 6951

6894 (SLAC-PUB—2104) **New results from DELCO.** Nodulman, L.J. (Stanford Linear Accelerator Center, CA (USA)). Mar 1978. Contract EY-76-S-03-0326. 6p. (CONF-780338—5). Dep. NTIS, PC A02/MF A01.

From 3. conference on new results in high energy physics; Nashville, TN, USA (6 Mar 1978).

New results from the DELCO experiment at SPEAR are presented. New data and reanalysis give conclusive evidence for the tau heavy lepton with mass 1.777 + 0.005 - 0.009 GeV/c^2. Preliminary branching ratios for the tau are discussed, along with analysis of the electron momentum spectrum, favoring V-A. A preliminary look at D beta decay at psi''(3770) in terms of K and K*(890) is also discussed.

6895 (SLAC-PUB—2127) **γ studies from DELCO.** Kirkby, J. (Stanford Univ., CA (USA)). Jun 1978. Contract EY-76-C-03-0326. 15p. (CONF-780453—8). Dep. NTIS, PC A02/MF A01.

From Neutrinos; West Lafayette, IN, USA (28 Apr 1978).

Data obtained at SPEAR in the DELCO experiment show conclusively that the tau is a spin ½ lepton. The electron momentum spectrum (characterized by a Michel parameter, rho = 0.66 +- 0.13) observed in the decay tau⁻ → ν/sub tau/ e⁻ anti tau/sub e/ shows excellent agreement with a V-A current. The tau mass is found to be 1782^{+7}_{-7}/sub minus 7/ MeV/c² and the mass of the ν/sub tau/ is less than 250 MeV/c² (95 percent CL). The branching ratio for measured tau⁻ → ν/sub tau/ e⁻ anti ν/sub e/ is (0.160 +- 0.013) and for tau⁻ → ν/sub tau/ + greater than or equal to (3 charged particles)⁻ is (0.32 +- 0.05). A clear signal of the decay tau⁻ → π⁻ ν/sub tau/was observed and the branching ratio found to be (0.083 +- 0.03).

6896 **Multimuon production by neutrinos at FNAL.** Mann, A.K. (Univ. of Pennsylvania, Philadelphia). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 15-48(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Data on neutrino interactions involving two, three and four final state muons are summarized and the origins of such events are discussed. 31 references.

6897 **Scaling parameters in deep inelastic muon scattering.** Francis, W.R. (Michigan State Univ., East Lansing). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 339-353(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

New and still preliminary measurements of the nucleon structure function derived from muon scattering experiments at Fermilab are presented. The data are displayed in such a way as to emphasize the departures from exact Bjorken scaling. Parameters describing the scale breaking are extracted from simple power law fits to the data. 16 references.

6898 **Recent results on massive lepton pairs and the upsilon family.** Brown, C.N. (Fermi National Accelerator Lab., Batavia, IL). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 375-385(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

A progress report is given on the measurements currently made at Fermilab. Over 25,000 muon pairs with a mass M/sub μ/ + /sub μ/ - > 5 GeV produced by 400 GeV protons incident on a platinum target p + Pt → μ⁺ + μ⁻ + anything were accumulated. Based on a subset of this data the evidence for resonance-like structure, the upsilon, near 9.5 Gev in this spectra was published. Further details of the upsilon family and current understanding of the continuum of massive lepton pairs are presented. 12 references. (JFP)

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 6898, 6912, 6933

6899 (ANL-HEP-CP—78-36) **Resonant-like structures in proton—proton system.** Auer, I.P.; Colton, E.; Halpern, H. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 30p. (CONF-780826—5). Dep. NTIS, PC A03/MF A01.

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

A striking energy dependence was observed in the difference between the p—p total cross sections for parallel and antiparallel longitudinal spin states, Δ sigma/sub L/. The structure appears around p/sub lab/ = 1.5 GeV/c, where Δ sigma/sub L/ = -16.7 mb and is seen in sigma/sup Tot/(arrow-right arrow-right) rather than sigma/sup Tot/(arrow-right arrow-left). The experiments were performed at ANL using a standard transmission technique. From the dispersion analysis of a forward p—p scattering amplitude using the data on Δ sigma/sub L/, Grein and Kroll have shown that the Argand plot of the amplitude has a clear resonance-like behavior around proton incident momentum of 1.5 GeV/c. At the same energy range, the p—p polarization at fixed -t also shows a remarkable energy dependence. In addition, we have observed a prominent energy dependence for C/sub LL/, the spin correlation parameter for elastic pp scattering with beam and target both longitudinally polarized. The possibility of a resonance was further pursued by studying Legendre expansion coefficients of p—p differential cross section and polarization data. The analysis showed a partial wave, $^3F_3$, consistent with having a resonant behavior. This resonant state would have the quantum number J/sup P/ = 3⁻, mass approximately 2260 MeV, width approximately 200 MeV and elasticity 20 to 30%. This exotic state may be described by the MIT bag model. Also several more diproton resonances are speculated in the mass region 2100 to 2800 MeV. 23 references.

6900 (ANL-HEP-CP—78-37) **Asymmetry measurements in p—p scattering with polarized beams and targets up to 12 GeV/c.** Auer, I.P.; Colton, E.; Halpern, H.; Hill, D.; Spinka, H.; Tamura, N.; Theodosiou, G.; Underwood, D.; Wanger, R.; Watanabe, Y.; Yokosawa, A. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 291p. (CONF-780826—6). Dep. NTIS, PC A03/MF A01.

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

The processes of proton—proton scattering for various spin directions was investigated in the beam momentum range of 1 to 12 GeV/c. A striking energy dependence was observed at p/sub lab/ = 1 to 4 GeV/c, especially in Δ sigma/sub L/, the total cross section difference in the longitudinal spin states. The rapid energy dependence has been interpreted as evidence for the formation of diproton resonances. Various pp scattering parameters were measured at 6 GeV/c, including 3-spin parameters, which are sufficient to determine pp elastic scattering amplitudes in a model independent way at 0.2 < absolute value of t < 0.8 (GeV/c)². Measurements of spin—spin correlation parameters were extended to higher t and higher energies, revealing the importance of the spin dependent interaction. These measurements may shed light on the nature of the constituents and their interactions. 24 references.

6901 (CU-TP—126) **New techniques for evaluating parity-conserving and parity-violating contact interactions.** Hiller, J.; Sucher, J.; Feinberg, G. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy; Columbia Univ., New York (USA). Dept. of Physics). Apr 1978. Contract EY-76-S-02-3117. 37p. Dep. NTIS, PC A03/MF A01.

The accurate evaluation of expectation values such as I_1 = [psi vertical bar delta(r vector$_1$) vertical bar psi] and I_{12} = [psi vertical bar delta(r vector$_1$—r vector$_2$) vertical bar psi] where psi = psi(r vector$_1$,r vector$_2$,...r vector/sub N/) is an eigenfunction of a Hamiltonian H is of interest for a variety of problems in atomic physics. Transformations are found to new forms I_1' and I_{12}' which are likely to give considerably more accurate values when, as is usually the case, only approximate wave functions are available. A successful test of the method is presented for the case of electron-electron and electron-nucleus contact interactions in helium. Some identities are given which may be similarly useful in the evaluation of off-diagonal matrix elements of relativistic operators such as γ$_5$ delta(r vector$_1$), which arise from the parity-violating part of the neutral-current interaction and are important in the calculation of parity-mixing in atoms.

6902 **Energy dependence of spin-spin forces in 90°sub(cm) elastic p-p scattering.** Lin, A. (Abadan Institute of Technology, Abaden, Iran); O'Fallon, J.R.; Ratner, L.G.; Schultz, P.F. (Argonne National Lab., Ill. (USA)); Abe, K.; Crabb, D.G.; Rernow, F.C.; Krisch, A.D.; Salthouse, A.J.; Sandler, B. *Phys. Lett., B;* **74**: No. 3, 273-276(10 Apr 1978).

The authors measured dsigma/dt(90°sub(cm)) for p(spin up) + p(spin up) → p + p from 1.75 to 5.5 GeV/c by using the Argonne zero-gradient synchrotron 70% polarized proton beam and a 70% polarized proton target. It was found that the spin-spin correlation parameter, Asub(nn), equals 60% at low energy, then drops sharply to about 10% near 3.5 GeV/c, and remains constant up to 5.5 GeV/c.

6903 **Recent experimental results on high transverse momentum scattering from Fermilab.** Fox, G.C. (California Inst. of Tech., Pasadena). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 193-238(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

A survey of recent high transverse momentum (P/sub perpendicular to/) scattering experiments at Fermilab concentrates on a comparison of three experiments that use a "jet" (i.e., sum over several particles) P/sub perpendicular to/ trigger. Also discussed are two-particle correlations and phi production. 39 references.

6904 **Nucleon—nucleon elastic scattering at large transverse momentum squared and spin.** Krisch, A.D. (Univ. of Michigan, Ann Arbor). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 243-270(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

A review is presented of nucleon—nucleon elastic scattering at large transverse momentum squared. Differential cross sections and the diffraction peak are plotted. Some models are also considered, particularly the Lorentz contracted geometric model. Finally spin at large P²/sub perpendicular to/ is discussed. 44 references. (JFP)

6905 Life and times of large P/sub T/ physics: diagnosis and prognosis. Ellis, S.D. (Univ. of Washington, Seattle). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 271-286(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

The historical development of large P/sub T/ physics is reviewed and a critical diagnosis of the difficulties confronting present understanding and existing models is given. The prognosis for future progress in this field is discussed. 60 references.

6906 Search for the leptonic decays of charmed baryons and mesons. Knapp, B. (Columbia Univ., New York); Lee, W.; Leung, P. pp 43-63 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

The experiments were performed in the broad band neutral beam at Fermilab, which for purposes of charmed particle production and detection had a useful photon spectrum that extended from about 100 to 200 GeV. Previously reported was the observation of a narrow antibaryon state at 2.26 GeV/c², which is consistent with the predictions of the lowest mass charmed baryon. The events in the region of the narrow resonance were examined to see if they are accompanied by a track that could be identified as either an electron or a muon. The number of such events observed is not significantly (statistically) above what one expects from the background of either misidentified pions or pions decaying in flight to muons. Also a lepton signal was chosen and the question was asked, "Are there K/ sup Q//sub S/ ($n\pi$) events in coincidence which have a significant peak at the mass of the D mesons. These would have arisen from the pair production of D mesons and the subsequent decay of one semileptonically and the other purely hadronically. In the data from earlier runs, no statistically significant peak was seen at the mass corresponding to the D mesons for a variety of decay modes. If one uses theoretical estimates for the photoproduction and various branching ratios of D mesons, the level is commensurate with the observation of some events. 5 references.

6907 Experimental review on the baryon—antibaryon interaction. Montanet, L. (CERN, Geneva). pp 260-294 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

Experimental evidences for baryon-antibaryon bound and resonant states are reviewed. The S(1936), T(2190) and U(2350) puzzle is discussed. Strong evidences for spin 3, 4, 5 resonances from anti p p $\rightarrow \pi\pi$ are presented. The observation of narrow proton-antiproton peaks in production experiments is reported. The status of the S = +- 1 baryon-antibaryon system is briefly reviewed. 33 references.

6908 CERN OMEGA spectrometer. Dowell, J.D. (Univ. of Birmingham, Eng.). pp 367-387 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

Results relevant to the field of meson spectroscopy obtained at the CERN PS and SPS using the Omega spectrometer are reviewed. The detector is briefly described and examples of results both published and unpublished are given with references. Future plans are mentioned. 19 references.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 6887, 6890, 6894, 6898, 6903, 6905, 6906, 6907, 6908, 6932, 6936

6909 (ANL-HEP-PR—78-22) Amplitude analysis of the K^-K^+ system produced in the reactions $\pi^-p \rightarrow K^-K^+N$ and $\pi^+N \rightarrow K^-K^+p$ at 6 GeV/c. Cohen, D.; Ayres, D.S.; Diebold, R.; Kramer, S.L.; Pawlicki, A.J.; Wicklund, A.B. (Argonne National Lab., IL (USA)). Jun 1978. Contract W-31-109-ENG-38. 56p. (CONF-780826—1). Dep. NTIS, PC A04/MF A01.

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

An amplitude analysis of the K^-K^+ system produced in the reactions $\pi^-p \rightarrow K^-K^+n$ and $\pi^+n \rightarrow K^-K^+p$ was carried out using data from a high statistics experiment carried out with the Argonne Effective Mass Spectrometer. Combining the results from the two reactions allows the separation of the KantiK production amplitudes into their isospin-zero and one components. An enhancement is deserved in the S-wave amplitude near 1300 MeV which we call the S'. Using various physical arguments, including the t dependence of the amplitudes, six out of eight mathematically-allowed solutions can be eliminated for the magnitudes and phases of the amplitudes and shown that this new S-wave state has isospin zero. Requiring a reasonable behavior for the isospin-one P wave shows that the S' amplitude has a slow phase variation through the peak region.

6910 (ANL-HEP-PR—78-24) Measurement of exclusive hypercharge-exchange reactions at 35 to 140 GeV/c. Arenton, M. W.; Ayres, D.S.; Cohen, D. (Argonne National Lab., IL (USA)). Jul 1978. Contract W-31-109-ENG-38. 11p. (CONF-780826—4). Dep. NTIS, PC A02/MF A01.

From 19. conference on high energy physics; Tokyo, Japan (23 Aug 1978).

Data on the reactions $\pi^+ p \rightarrow K^+\Sigma^+$ and $\pi^+p \rightarrow K^+Y^{*+}$ were obtained using the Fermilab Single Arm Spectrometer Facility at incident π^+ momenta of 35, 70, and 140 GeV/c for momentum transfers vertical bar t vertical bar less than or approximately equal to 1 GeV². The line-reversed reactions $K^-p \rightarrow \pi^-\Sigma^+$ and $K^-p \rightarrow \pi^-Y^{*+}$ were also studied at 70 GeV/c with the same apparatus in order to test exchange degeneracy of the K*(890) and K**(1420) trajectories. Preliminary results on the first set of reactions at 70 GeV/c are presented and found to be in qualitative agreement with the model of Navelet and Stevens.

6911 Light-quark meson spectroscopy. Flatte, S.M. (Univ. of California, Santa Cruz). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 103-116(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Recent results in the spectroscopy of mesons formed from light quarks are placed in a systematic experimental context. 36 references.

6912 Production of high transverse momentum π^0's at the CERN ISR. Pope, B.G. (Princeton Univ., NJ). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 239-242(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

The CERN-Columbia-Oxford-Rockefeller experiment is described. Data are presented from the P + P $\rightarrow \pi^0$ + anything interaction at $\sqrt{s}$ = 52.7 and 62.4 GeV. A π^0 is defined to be an energy cluster in adjacent lead blocks contained in a 3 x 3 matrix. Preliminary results on the cross sections as functions of transverse momentum are shown. (JFP)

6913 High resolution measurement of πp elastic scattering near 90° c.m. Price, L.E. (Columbia Univ., NY); Jenkins, K.A.; Klem, R.; Miller, R.J.; Schreiner, P.; Courant, H.; Makdisi, Y.I.; Marshak, M.L.; Peterson, E.A.; Ruddick, K. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 473-477(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Large angle $\pi^{+-}p$ elastic scattering cross sections were measured between 2 and 9 GeV/c in fine intervals of incident momentum and scattering angle. The data are used to test predictions of the quark parton model and the statistical bootstrap model. 7 references.

6914 Line reversal in baryon exchange processes. Russ, J. (Carnegie-Mellon Univ., Pittsburgh); Edelstein, R.; Green, D. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 485-489(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Differential cross sections at 6 GeV/c are presented for π^- and anti p-induced baryon exchange reactions. These data are used to test line-reversal symmetry in baryon exchange. Nearly identical triggers were used for each reaction, so that systematic errors in the line reversal tests are small. 1 reference.

6915 Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977). 450p. (CONF-770406—).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

The conference included 23 papers, seven of which appeared previously in ERA. Separate abstracts were prepared for 16 papers. (JFP)

6916 Recent results in charmonium spectroscopy. Feldman, G.J. (Stanford Univ., CA). pp 1-16 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

Three topics in charmonium spectroscopy are discussed: the evidence for chi states and their spin and parity assignments, the possibility of c anti c mixing in pseudoscalar states, and tests of the OZI rule. 13 references.

6917 Quark chemistry: charmonium molecules. De Rujula, A. (Harvard Univ., Cambridge, MA); Jaffe, R.L. pp 83-98 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

The theoretical and experimental evidence for two quark-two antiquark hadrons is reviewed. Concentration is placed on predictions for S-wave "charmonium molecules," built of a c anti c charmonium pair and a light quark-antiquark pair. Their spectrum and quantum numbers are predicted and an estimate of their decay couplings and their prediction in monochromatic pion decays from charmonium resonances produced in e^+e^--annihilation is given. Some S-wave charmonium resonances should be detectable in these decays, but typical branching ratios are only at the 1% level. 19 references.

6918 Spectrometer study of $\pi^+\pi^-\pi^0$ and eta$\pi^+\pi^-$. Edwards, K.W. (Carleton Univ., Ottawa); Legacey, D.; Brockman, P. pp 312-326 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

A study is made of the reaction $\pi^- p \rightarrow \pi^+\pi^-\gamma\gamma n$ with high statistics at 8.5 GeV with a charged and neutral particle spectrometer. Both charged pions and both γ's are detected. The search is made for the $\pi^+\pi^-\pi^0$ decays of the neutral A_1 and the two missing isoscalar companions of the B, and are seeking to clarify the status of the D and E mesons in $\pi^+\pi^-$ eta. 6 references.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

REFER ALSO TO CITATION(S) 6841, 6845, 6846, 6950, 6953, 7004

6919 (SLAC-PUB—2132) **Experimental summary of the XIII Rencontre de Moriond.** Perl, M.L. (Stanford Linear Accelerator Center, CA (USA)). Jun 1978. Contract EY-76-S-03-0326. 54p. (CONF-780353—4). Dep. NTIS, PC A04/MF A01.

From 13. high energy hadronic interactions sessions; Les Arcs, France (12 Mar 1978).

This is the written version of a summary talk on some of the experimental results presented at the XIII Rencontre de Moriond. Results are reviewed in the following areas: studies of the quark-parton model, Bjorken scaling, and quark fragmentation using virtual photons, neutrinos, and e^+e^- annihilation; properties of the tau lepton, D charmed meson, and F charmed meson as measured in e^+e^- annihilation; production of charmed particles by photons, neutrinos, and hadrons, including the CERN beam dump experiments; and ongoing searches for new particles.

6920 Thomas—Bargmann—Michel—Telegdi equation for Wigner particles. Bacry, H. pp 449-453 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

An attempt is made towards a covariant Hamiltonian description for a quantum mechanical as well as classical system of elementary particles in interaction. 11 references. (JFP)

6921 Group theoretic treatment of the number operator of particles. Strasburger, A.; Szczyrba, I. pp 501-506 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The treatment of the number operator of particles using group theory begins with a consideration of the symmetry types of tensors. The results have physical significance in that the classical cases of the Fermi and Bose particles are clearly covered by the assumptions made and hence they possess the unique number operator. 7 references. (JFP)

6922 Theoretical charmonium spectroscopy. Yan, T.M. (Cornell Univ., Ithaca, NY). pp 64-80 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

The theoretical ideas leading to the formulation of the charmonium model are reviewed. Its predictions are compared with experiment. The effect of coupling to decay channels is briefly discussed. 32 references.

6923 What have we learned about quark forces from charmonium. Schnitzer, H.J. (Brandeis Univ., Waltham, MA). pp 81-82 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

The emphasis of these remarks is directed towards those features of charmonium dynamics which can provide information on the q anti q forces. (JFP)

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 6926, 6929, 6944, 6952

6924 Poincare group and magnetic charge. Villarroel, D. pp 507-514 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

An attempt is made to give a canonical Hamiltonian formulation for a system of classical electric and magnetic charges without the introduction of potentials. 2 references. (JFP)

6925 Some comments on the production of prompt leptons. Adair, R.K. (Yale Univ., New Haven). pp 99-115 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

Two subjects are discussed. Analyses of measurements of the properties of the bulk of the inclusive prompt muon flux produced in nucleon—nucleon interactions show that the muons are produced in pairs through electromagnetic processes and that a substantial part of the production is not derived from meson decays or from parton bremsstrahlung. A comparison of the cross sections for the production of the J/psi* and the psi* in hadron interactions and the Drell-Yan cross sections for lepton pairs shows that the simple parton model fails to account for the meson production cross section by an order of magnitude though the qualitative features of the production are in accord with the properties derived from such a model. 32 references.

WEAK INTERACTIONS

6926 (SLAC-PUB—2131) **New limits on quark and lepton weak couplings.** Barnett, R.M. (Stanford Linear Accelerator Center, CA (USA)). Jun 1978. Contract EY-76-C-03-0326. 24p. (CONF-780453—7). Dep. NTIS, PC A02/MF A01.

From Neutrinos; West Lafayette, IN, USA (28 Apr 1978).

The unique determination of the weak neutral-current couplings of u and d quarks is discussed. Knowledge of these quark couplings has important implications for the determination of the electron's couplings. Recent data provide new restrictions on the charged-current couplings of quarks. The implications of these analyses for weak and electromagnetic gauge theories of quarks and leptons are examined.

6927 Determining the fifth quark's charge: the role of the UPSILON leptonic widths. Rosner, J.L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy); Quigg, C.; Thacker, H.B. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). *Phys. Lett., B;* **74**: No. 4, 5, 350-352(17 Apr 1978).

Lower bounds on the leptonic decay widths of UPSILON 9.4 and UPSILON' (10.0) are deduced from plausible general assumptions. It is shown that these may permit a distinction between the charge assignments e/sub Q/ = (-1/3, +2/3) for the new quark.

6928 Neutral-current constraints on gauge models of weak and electromagnetic interactions. Langacker, P. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics); Sidhu, D.P. (Brookhaven National Lab., Upton, N.Y. (USA)). *Phys. Lett., B;* **74**: No. 3, 233-238(10 Apr 1978).

Sehgal and Hung and Sakurai have recently argued that neutrino-hadron neutral-current couplings must lie in one of two allowed regions in coupling-parameter space. This conjecture is studied using realistic BNL ν/sub μ/ and anti ν/sub μ/ spectra in the elastic ν/sub μ/p (anti ν/sub μ/p) calculations, and constraints imposed by the q^2-distributions are also studied. On comparing to gauge models, it is found that the Weinberg-Salam and SU(2)/sub L/ X SU(2)/sub R/ X U(1) models fall within one allowed region, while a vectorlike SU(3) X U(1) model and a hybrid SU(2) X U(1) model with a (u, b)/sub R/ doublet fall in the other region.

STRONG INTERACTIONS, GENERAL

6929 Heavy quark production. Sivers, D. (Argonne National Lab., IL). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 287-296(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

The alchemy of the production of states containing the heavy quarks in hadron-hadron or photon-hadron collisions offers an opportunity to study hadronic dynamics in a manner not readily available elsewhere. The focus is on an approach based on a simple interpretation of QCD developed at Illinois and Argonne. This approach seems to offer the possibility of forming a connection between the dynamics of heavy particle production and recent developments in the theory of large-transverse-momentum processes. It is very interesting to see how the connection with large-P/sub T/ emerges from a fairly reasonable model. In the model discussed, the production of heavy quarks in photoproduction is thought of as arising from diagrams which constitute the lowest-order-QCD process available and are considered applicable either for a real photon or for a virtual photon arising from inelastic lepton scattering. 25 references. (JFP)

6930 Charm is not enough. Glashow, S.L. (Harvard Univ., Cambridge, MA). pp 420-425 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

Problems of the standard model and the charmed quark are discussed, and a list is given of expriments to be performed in order to illuminate the theoretical puzzles. (JFP)

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 6915

6931 (BNL—50812) **Quark line diagrams, rules and some recent data.** Lindenbaum, S.J. (Brookhaven National Lab., Upton, NY (USA)). 27 Dec 1977. Contract EY-76-C-02-0016. 20p. Dep. NTIS, PC A02/MF A01.

The Okubo, Zweig, Iizuba rule, referred to as the quark-line rule, is considered in its various aspects, and it is pointed out that the quark line rule alone has some serious limitations. But by an appropriate expansion into a set of quark line diagram rules based on observations and other dynamical considerations, it may be possible to develop quark line diagram techniques that are applicable to hadron dynamics in a qualitative and perhaps even semi-quantitative sense analogous to the way Feynman graphs and their associated rules are used in both a qualitative and semi-qualitative sense in many instances of hadron dynamics. The primary concern is with the u, d, and s quarks. The decays of ω and phi mesons and $\pi^- + p$ interactions are discussed with regard to the quark line diagrams. 9 references. (JFP)

6932 Baryonium: a special kind of exotica. Rosenzweig, C. (Syracuse Univ., NY). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 117-144(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Various theoretical ideas based on nuclear physics, duality, string models, QCD, and bag models which lead to the expectation of massive mesons coupled strongly to baryon-anti-baryon channels but weakly to meson systems are reviewed. A survey of the exciting experimental discoveries which have re-awakened interest in the subject is given. The data indicate that there is still a great deal to learn and discover. 50 references.

6933 Observation of a new regularity in hadronic spectra. Raja, R. (Fermi National Accelerator Lab., Batavia, IL). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 479-484(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Evidence is presented in 100 GeV/c anti p p interactions for the hypothesis that the ratio of an inclusive cross section ab → anti c + X to ab → anti c + X/sub s/, where X/sub s/ is a subset of X, is a function of M^2, the effective mass squared of X (and X/sub s/) only and not of s and t. A summary of the rationale leading up to the hypothesis is also given. The hypothesis is seen to be obeyed in all areas of phase space in the reaction considered. 4 references.

6934 Kπ and ππ data and partial wave analysis. Estabrooks, P. (McGill Univ., Montreal, Can.). pp 185-206 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

The present status of Kπ and ππ spectroscopy is briefly reviewed. New results for Kπ partial waves calculated using data from a high statistics 13 GeV/c SLAC spectrometer experiment are presented. The $I = 3/2$ cross section is found to be dominantly S wave, and significantly larger than the previously accepted value of 1.8 mb. There is evidence for a new 0^+ Kπ resonance near 1450 MeV, as well as, in two of the four possible partial wave solutions, a P wave resonance near 1700 MeV. The remarkable similarity between Kπ and ππ partial waves is noted. Possible directions for future study are suggested. 24 references.

6935 In search of the A_1. Longacre, R.S.; Aaron, R. (Northeastern Univ., Boston). pp 327-346 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

Neither the A_1 nor other unnatural parity resonances (except for the eta) have been "seen" in 3π production experiments. One can inquire whether the A_1 and these other long-sought unnatural parity states (which are demanded by the quark model) are buried in the backgrounds which dominate these reactions. The answer to this question is explored and a unitary isobar model developed which incorporates both Deck background and resonance (A_1) production. Application of this model to existing 3π (and K* anti K) data gives reasonably definitive evidence that, in fact, the A_1 does exist with mass M/sub A/ approximately = 1450 MeV and width GAMMA/sub A/ approximately = 350 MeV. Partial widths into rho π, epsilon π, and K* anti K are also discussed. Finally, the possibility is considered of detecting the A_1 free of background. 29 references.

STRONG INTERACTIONS, BARYON NO.=1

REFER ALSO TO CITATION(S) 6931

6936 Report on the ACNO collaboration. Hemingway, R.J. (CERN, Geneva). pp 295-311 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

A very brief report is presented of some recent meson results from the ACNO collaboration. These are a partial wave analysis of the 3π system in the reaction $K^- p \rightarrow \pi^+ \pi^- \pi^0$LAMBDA, a measurement of the eta' spin-parity, and nondiffractive production of a spin-parity 1^+ rho π enhancement at 1.04 GeV. 11 references.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 6904, 6925

6937 (COO—3227-71) **Impact picture and internal matter motion for elastic scattering.** Bourrely, C.; Soffer, J.; Wu, T.T. (Harvard Univ., Cambridge, MA (USA); Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique; Rijksuniversiteit Utrecht (Netherlands). Instituut voor Theoretische Fysica). 1978. Contract EY-76-S-02-3227. 37p. (CONF-7806111—1). Dep. NTIS, MF A01.

From Meeting on hadron physics at high energies; Marseille, France (5 Jun 1978).

Portions of document are illegible.

Since four-dimensional relativistic quantum field theories have all the desirable properties such as particle production, unitarity, and analyticity, they provide a useful way to gain theoretical knowledge not only for weak and electromagnetic processes but also for strong interactions. For the dynamics of strong interactions, because of the necessity of understanding all orders of perturbation theory, the simplest case is the high energy limit. After a brief review of the general features of elastic scattering in field theories, the need of developing a phenomenology in order to make contact with present and future experimental data is discussed. Such a phenomenology must satisfy the dual requirement of, on the one hand, giving an accurate description of hadronic experimental data at high energies and, on the other hand, having the s → infinity behavior obtained from field theories. Recent improvements on such a phenomenology are emphasized, and include better parametrization and proper Regge background and spin effects. In particular, the spin of the proton is taken into account by using the concept of hadronic matter current of Chou and Yang. In addition to the total and differential cross sections for ISABELLE energies, predictions are obtained for both polarization and R parameters for proton—proton elastic scattering. Sore theoretical problems for the future are outlined.

6938 (LA-UR—78-2227) **Polarization effects in the 3-body system.** Ohlsen, G.G. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-26. 25p. (CONF-780833—2). Dep. NTIS, PC A02/MF A01.

From Conference on few body systems and nuclear forces; Graz, Austria (24 Aug 1978).

An experimental review is given of polarization effects in the three-nucleon system. Inelastic processes are emphasized and some special topics on elastic scattering are also considered. The recent elastic nucleon—deuteron scattering result are discussed including

the determination of the deuteron D state, vector n - d vs vector p - d vector analyzing power, the status of fits to polarization observables via Faddeev-type theory, and medium-energy elastic scattering. The treatment of the breakup experiments covers a general discussion of some of the possible kinematically complete breakup measurements and kinematically incomplete breakup experiments. 71 references. (JFP)

6939 Evidence for baryonium exchange in medium and high energy scattering. Nicolescu, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., B;* **134**: No. 3, 495-520(20 Mar 1978).

The prominent effects supposed to be associated with the exchange of baryonium Regge trajectories are reviewed. The experimental presence of all expected effects leads the author to suggest that the baryonium exchange mechanism is a correct phenomenological picture and that mesons with isospin 2 or 3/2 or with strangeness -2, strongly coupled to be baryon-antibaryon channels, must be observed. An unexpected enhancement of the pure baryonium channel cross sections in the case of baryon decuplet production is pointed out. It is also shown that the old rho' puzzle in $\pi^- p \to \pi^0 n$ seems to be solved by considering a recent generalization of the baryonium concept.

6940 Gluon contribution to hadronic J/PSI production. Glueck, M. (Univ., Mainz); Owens, J.F.; Reya, E. *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 467-471(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

Using the recent CERN and Fermilab measurements for J/psi production by π^{+-}, K^{+-}, p and anti p beams it is shown, within the framework of QCD, that only a combined version of light quark q anti q → c anti c fusion and gluon gg → c anti c fusion mechanisms can account for the various total cross section beam ratios as well as for the observed x/sub F/-distributions. 10 references.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

REFER ALSO TO CITATION(S) 6955, 6996, 6999, 7002, 7005

6941 Spontaneous breaking of exceptional groups. Guersey, F. pp 213-230 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

It is shown how the groups F_4, E_6, and E_7 arise as the octonionic generalization of the more familiar groups SU(3), SU(3) x SU(3) and SU(6), with the octonions providing the additional color degrees of freedom. Then the algebraic properties of the special directions obtained through spontaneous symmetry breaking of the unitary groups are reviewed. The algebras and the special directions are further generalized to exceptional groups. Finally, the result is compared with the hierarchy of interactions suggested by experiment. 36 references. (JFP)

6942 Some aspects of graded Lie algebras. Backhouse, N. pp 249-254 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The theory of graded (or pseudo) Lie algebras has recently been elevated by the realization that it is at the heart of supersymmetry. It is shown that a number of the concepts and results which arise in Lie algebra theory carry over to the wider context of graded Lie algebras. 4 references. (JFP)

6943 Theory of coherent quarks. On the dynamical origin of the Okubo—Zweig—Iizuka rule. Hongoh, M. pp 303-311 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

A possible dynamical origin of the Okubo-Zweig-Iizuka rule is investigated by constructing new basis functions for SU(3), which are analogous to the SU(2) Bloch coherent states. 9 references. (JFP)

6944 Subgroups of Lie groups and symmetry breaking. Winternitz, P. pp 549-572 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

It is shown how a certain research program has applications in a systematic study of symmetry breaking. This program is one of classifying all closed subgroups of a given Lie group G into conjugacy classes under some group of automorphisms of G and finding a representative of each class. A nonrelativistic particle in an external potential and subgroups of E(3), the time dependent linear and nonlinear Schroedinger equations, the hydrogen atom in an external electromagnetic field, and discrete subgroups of 0(3) and symmetry adapted wave functions are treated. 16 references. (JFP)

6945 Conformal harmonic analysis and intertwining differential operators. Jakobsen, H.P. pp 573-576 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

A few results are described from the development of a theory for elementary particles, in particular, the interplay between representations of the conformal group in the form of SU(2,2) and classical mass--zero equations are given. 1 reference. (JFP)

6946 New directions in supersymmetries. Arnowitt, R. (Northeastern Univ., Boston). pp 160-169 of Experimental meson spectroscopy 1977. von Goeler, E.; Weinstein, R. (eds.). Boston; Northeastern University Press (1977).

From 5. international conference on experimental meson spectroscopy; Boston, MA, USA (29 Apr 1977).

A brief survey is given of the basic ideas behind global supersymmetry, and the theoretical advantages accruing in extending this to a local gauge invariance. Gauge supersymmetry is described, and an 8 quark model based on it yielding a high y-anomaly and a null atomic physics result is presented. 12 references.

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

6947 Progress in weak interaction theory. Zee, A. (Inst. for Advanced Study, Princeton, NJ). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 49-63(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

A rather noncomprehensive review of the current status of weak interaction is given. Topics discussed include the atomic parity experiments and muon number nonconservation, neutrino sharing, the nature of parity violation, the use of discrete symmetry, six dominance and the $\Delta I = 1/2$ rule, Higgs bosons, and the question of dynamical symmetry breaking. 80 references.

APPLICATIONS TO STRONG INTERACTIONS

6948 Progress toward a theory of the strong interactions. Gross, D.J. (Inst. for Advanced Study, Princeton, NJ). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 145-165(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

The most promising candidate for a fundamental microscopic theory of the strong interactions is a gauge theory of colored quarks—quantum chromodynamics (QCD). There are many excellent reasons for believing in this theory. It embodies the broken symmetries, SU(3) and chiral SU(3) xSU(3), of the strong interactions and reflects the success of (albeit crude) quark models in explaining the spectrum of the hadrons. The hidden quantum number of color, necessary to account for the statistics of the low lying hadrons, plays a fundamental role in this theory as the SU(3) color gauge vector mesons are the mediators of the strong interactions. The absence of physical quark states can be "explained" by the hypothesis of color confinement, i.e. that hadrons are permanently bound into color singlet states. Finally this theory is unique in being asymptotically free, thus accounting for the almost free field theory behavior observed at short distances. 14 references.

FIELD THEORY

REFER ALSO TO CITATION(S) 6946, 6948, 7005

6949 (ANL-HEP-PR—78-23) **Introductory lectures on fibre bundles and topology for physicists.** Thomas, G.H. (Argonne National Lab., IL (USA)). May 1978. Contract W-31-109-ENG-38. 208p. Dep. NTIS, PC A10/MF A01.

These lectures may provide useful background material for understanding gauge theories, particularly the nonperturbative effects such as instantons and monopoles. The mathematical language of topology and fibre bundles is introduced.

6950 (COO—2271-101) **Theoretical high energy physics. Progress report, 1 May 1977—30 Apr 1978.** Lee, T.D. (Columbia Univ., New York (USA). Dept. of Physics). Jun 1978. Contract EY-76-S-02-3117. 20p. Dep. NTIS, PC A02/MF A01.

Research in theoretical high energy physics is summarized with primary emphasis placed on quantum field theory. (JFP)

6951 (COO—3064-11) **Experimental tests of QCD.** Sessoms, A.L. (Harvard Univ., Cambridge, MA (USA). Dept. of Physics). 1978. Contract EY-76-C-02-3064. 21p. (CONF-780145—2). Dep. NTIS, PC A02/MF A01.

From Orbis scientiae conference; Coral Gables, FL, USA (15 Jan 1978).

The possibility of testing quantum chromodynamics in deep inelastic muon scattering from an experimental view point is discussed. The instruments and quality of data available for such tests are shown, then an indication is given of the very first attempts to make a comparison between these data and quantum chromodynamics predictions in semi- inclusive hadron production. The results are preliminary and in some cases merely suggestive of the possibilities. It is concluded that studies are on the verge of providing a test of quantum chromodynamics experimentally. 7 references. (JFP)

6952 (SLAC-PUB—2121) **Applications of QCD.** Ellis, J. (European Organization for Nuclear Research, Geneva (Switzerland); Stanford Linear Accelerator Center, CA (USA)). May 1978. Contract EY-76-S-03-0326. 27p. (CONF-780495—1). Dep. NTIS, PC A03/MF A01.

From Symposium on current trends in the theory of fluids; Tallahassee, FL, USA (6 Apr 1978).

A review is given of reliable quantum chromodynamics predictions which either have or soon can be verified by experiment. Included are a discussion of the classic application of quantum chromodynamics perturbation theory and asymptotic freedom to predict scaling violations in deep inelastic leptoproduction experiments, with emphasis on the first direct experimental confirmation of the numerical values of the anomalous dimensions; a review of recent advances in developing and justifying quantum chromodynamics perturbation theory predictions for a number of physical applications not underwritten by the operator product expansion and renormalization group arguments; and mention of attempts to consider the reliability of quantum chromodynamics perturbation theory predictions, given the fact that nonperturbative effects are presumably crucial in quantum chromodynamics. 100 references. (JFP)

6953 **Corpuscular theory of unified field and the origin of natural forces.** Shneiderov, A.J. (Polycultural Institution of America, IPI, Washington, DC). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 497-501(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

A running description of the radional field theory is presented, and it is demonstrated that many apparently complicated, natural phenomena can be explained in terms of this theory, often without using elaborate physical-mathematical structures and substructures. The initial postulate of this theory is a field of subparticles, the radions, which populate the so-called empty spaces in nuclei, in and outside atoms and physical bodies, in and between stars, galaxies, galactic clusters, and so on; and of which the nucleons, and all other fundamental particles of the micro-world are formed. 3 references. (JFP)

6954 **Gauge theory of the conformal group.** Harnad, J.P.; Pettitt, R.B. pp 277-301 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The gauge principle has been the basis for generating unified field theories for elementary particle interactions and may also be used to arrive at a formulation of general relativity in terms of elementary matter and gauge fields. The geometric structure underlying gauge theories in the language of fibre bundles is outlined. The particular case of the bundle P^2 (M) of second-order frames is then discussed, together with the sub-bundle of conformal frames. A separate discussion is given concerning the gauge theory related to the full conformal group. 18 references. (JFP)

SCATTERING THEORY

REFER ALSO TO CITATION(S) 6944, 6980

6955 **Finite representations of the unitary group and their applications in many-body physics.** Kramer, P. pp 173-179 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The definition and algebraic properties of certain square symbols appearing in the finite irreducible representations of the group U(n) are given. This concept is linked to properties of the symmetric group S(N) and its representations. It is claimed that the recent developments of the technique of S(N) for many-body physics are closely related to the properties of these square symbols. 6 references. (JFP)

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

6956 (COO—4052-02) **Investigations of nuclear structure and nuclear reactions induced by complex projectiles. Technical progress report, November 1, 1977—October 31, 1978.** Sarantites, D.G. (Washington Univ., St. Louis, MO (USA). Dept. of Chemistry). 1978. Contract EY-76-S-02-4052. 78p. Dep. NTIS, PC A05/MF A01.

Work in progress or completed during the last two contract years is summarized first. Often the summary is a photocopy of the first page of a published article, but longer reports are also included. General areas of interest are fusion reactions, strongly damped heavy-ion collisions, and nuclear structure at high angular momentum. Then the present status of instrumentation and analysis is reviewed; apparatus for γ-ray and particle multiplicity experiments, a magnetic lends--Si(Li) versatile conversion electron spectrometer, a total-energy or coincidence-summing spectrometer, detection equipment, and data acquisition and reduction are discussed. Lists of publications and scientific and technical personnel complete the report. 19 figures, 2 tables. (RWR)

6957 (LA—7301-PR) **Applied nuclear data research and development. Progress report, January 1—March 31, 1978.** Baxman, C.I.; Young, P.G. (comps.). (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 32p. Dep. NTIS, PC A03/MF A01.

Research during the first quarter of CY78 is reported in brief summaries. The general areas of work were the following: theory and evaluation of nuclear cross sections; nuclear cross-section processing; and fission products and actinides: yields, yield theory, decay data, depletion, and buildup. Two papers with significant amounts of information are abstracted separately. 8 figures, 8 tables. (RWR)

6958 **Evaluated Nuclear Structure Data File (ENSDF) for basic and applied research.** Ewbank, W.B. (Oak Ridge National Lab., TN). *CODATA Bull.;* No. 23, 32-36(May 1977).

From 5. international CODATA conference; Boulder, CO, USA (Jun 1976).

The structure and contents of the Evaluated Nuclear Structure Data file are described; this computer-based system is used for preparing publications and bibliographies and retrieving requested information. 11 figures. (RWR)

EXPERIMENTAL TECHNIQUES

6959 (CONF-780926—4) **Resonance capture reactions with a total energy detector.** Macklin, R.L. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

From 3. symposium on neutron capture of gamma-ray spectroscopy; Upton, NY, USA (18 Sep 1978).

The determination of nuclear reaction rates is considered; the Moxon—Rae detector and pulse height weighting are reviewed. This method has been especially useful in measuring (n,γ) cross sections. Strength functions and level spacing can be derived from (n,γ) yields. The relevance of neutron capture data to astrophysical nucleosynthesis is pointed out. The total gamma energy detection method has been applied successfully to radiative neutron capture cross section measurements. A bibliography of most of the published papers reporting neutron capture cross sections measured by the pulse height weighting technique is included. 55 references. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

6960 (ORO—5126-39) **Four-body model of the four-nucleon system.** Fonseca, A.C. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jun 1978. Contract EY-76-S-05-5126. 58p. Dep. NTIS, PC A04/MF A01.

Using a nonrelativistic field theoretic formalism a soluble model of the four-nucleon system is developed and solved numerically. Two- and three-body scattering proceeds through intermedi-

ate quasiparticles and the resulting T-matrices are separable in momentum space and satisfy two- and three-body unitarity. The 2+2 subamplitudes are treated exactly by the convolution method. The resulting four-body equations reduce to single variable integral equations following partial wave decomposition and can be solved numerically by rotation of contour together with matrix inversion. A complete phase shift calculation is performed for the isospin triplet interaction. The differential cross sections for all two-to-two processes initiated by p + ^{3}He, n + ^{3}H and d + d are compared with experiment for energies up to 25 MeV in the center of mass. Total elastic and reaction cross sections for the processes initiated by n + ^{3}H are also calculated and compared with experimental data.

6961 **Charge and double charge exchange in pion—nucleus scattering.** Spencer, J.F. (Los Alamos Scientific Lab., NM). pp 153-173 of 7th international conference on high energy physics and nuclear structure. Locher, M. (ed,). Basel; Birkhaeuser Verlag (1978).

Angle-integrated excitation functions for single charge exchange (SCE) to discrete two-body final states for both analog ($\Delta T = 0$, $\Delta T/sub\ z/ = 1$) and non-analog ($\Delta T = 1$, $\Delta T/sub\ z/ = 1$) transitions are now available. There are also π^{+-} elastic and SCE angular distributions on ^{3}He and ^{3}H at several energies. Similarly, the first measurements of both ($\Delta T = 0$, $\Delta T/sub\ z/ = 2$) and ($\Delta T = 2$, $\Delta T/sub\ z/ = 2$) transitions for double charge exchange (DCE) to discrete two-body final states were also made. There is no clear dominance of $\Delta T = 0$ analog transitions over ΔT not equal to 0 transitions for either SCE or DCE although the results are confined to rather low mass nuclei. Comparsion of very recent DCE results for different isotopes show some rather remarkable variations which indicate that these reactions provide a practical tool for both mass determinations and spectroscopic studies (e.g. ground state correlations) of nuclei far from the line of stability. Various calculations for these reactions based on multiple scattering theory are discussed for their use in interpreting the observations.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

REFER ALSO TO CITATION(S) 6843

ENERGY LEVELS AND TRANSITIONS

6962 **Isovector M6 excitations in the open-shell random phase approximation.** Rowe, D.J.; Wong, S.S.M.; Chow, H. (Toronto Univ., Ontario (Canada). Dept. of Physics); McGrory, J.B. (Oak Ridge National Lab., Tenn. (USA)). *Nucl. Phys., A;* **298**: No. 1, 31-42(27 Mar 1978).

OSRPA predictions are made for the excitation energies and transition amplitudes of $Jsup(\pi) = 6^-$, T = 1 excited states in the even N = Z sd shell nuclei. The results are employed in the calculation of electron scattering form factors. New expressions are given for the double commutators appearing in the OSRPA equations, which greatly facilitate their evaluation.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

6963 (BNL—24695) **Anomalous M-1 strengths and doorway states in neutron capture.** Peker, L.K.; Chrien, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 3p. (CONF-780926—11). Dep. NTIS, PC A02/MF A01.

From 3. symposium on neutron capture of gamma-ray spectroscopy; Upton, NY, USA (18 Sep 1978).

Recent experiments concerning the anomalous ratio of M1 and E1 strengths in ^{36}Cl and ^{57}Fe are interpreted as strong evidence for doorway state reaction mechanisms in neutron capture. 2 tables.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6963

6964 (LA-UR—78-2310) **Resonant heavy-ion elastic scattering from s-d shell nuclei.** DeVries, R.M. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 27p. Dep. NTIS, PC A03/MF A01.

Angular distributions at angles 130 less than theta/sub cm/ less than 180° were measured for ^{12}C + ^{28}Si, ^{32}S, ^{40}Ca as well as ^{9}Be, ^{13}C + ^{28}Si in the energy range 20 MeV less than or equal to E/sub cm/ less than or equal to 35 MeV. Cross sections rising towards 180° are observed for all reactions. Excitation functions for the back-angle enhancement show distinct structures, most pronounced for ^{12}C + ^{28}Si. Angular distributions for ^{12}C, especially those corresponding to peaks in the excitation function show oscillations of the type vertical bar P/sub J/(cos theta) vertical bar^2. The ^{12}C back-angle enhancement decreases with target mass. Backscattering of the nonalpha nuclei ^{9}Be and ^{13}C is reduced by about two orders of magnitude in comparison with ^{12}C. Similar measurements for the ^{28}Si(^{12}C, ^{16}O)^{24}Mg reaction and ^{16}O + ^{24}Mg elastic scattering allow comparison of reaction data with the corresponding entrance and exit channel data. Standard theoretical approaches fail to explain all the observed effects.

6965 (LBL—7598) **Two and four nuclon transfer reactions induced by heavy ions.** Mallet-Lemaire, M.C. (Bendix Corp., Kansas City, MO (USA)). May 1978. Contract W-7405-ENG-48. 21p. (CONF-780644—2). Dep. NTIS, PC A02/MF A01.

From 3. conference on clustering aspects of nuclear structure and nuclear reactions; Winnipeg, Canada (19 Jun 1978).

Two-nucleon-transfer reactions induced by heavy ions have been particularly successful in pointing out contributions of inelastic two-step processes. They provide a way to investigate the overlap between the wave functions of excited states of the target and residual nuclei. However, calculations of absolute cross sections must take into account sequential transfer. The studies of the (^{16}O,^{12}C) reaction on 1s—0d- and 0f—1p-shell nuclei are reviewed. The relative spectroscopic factors are in good agreement with those of the (^{6}Li,d) and (^{12}C,^{8}Be) reactions; hence, this reaction is evidently a good α-transfer reaction. However, some puzzling results are still not understood: excitation of unnatural-parity states in s—d shell-nuclei, the failure of EFR-DWBA calculations in reproducing the angular correlation measurements. Several experimental results showing that the ^{28}Si(^{18}O,^{14}C)^{32}Sreaction is not a good α-transfer reaction are presented. 11 figures, 4 tables.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 6962

NUCLEAR REACTIONS AND SCATTERING

6966 (LA—7482-PR, pp 5) **Calculation of the ^{39}K(n,2n)^{38}K cross section from threshold to 100 MeV.** Arthur, E.D. Sep 1978.

In Applied nuclear data research and development. Progress report, April 1—June 30, 1978.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 6963

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6963, 6964, 6965

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

6967 (LA—7301-PR, pp 2-5) **Calculation of the ^{88}Y(n,γ) cross section using gamma-ray strength functions.** Arthur, E.D. Jun 1978.

In Applied nuclear data research and development. Progress report, January 1—March 31, 1978.

The ^{88}Y(n,γ) cross section was calculated through use of the ^{90}Y E1 gamma-ray strength function. Results are presented for 1 keV to 10 MeV. 2 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 6969

NUCLEAR REACTIONS AND SCATTERING

6968 (COO—4052-02, pp 26-55) **Angular momentum transfer in deep inelastic scattering.** Dayras, R.A. (Oak Ridge National Lab., TN); Stokstad, R.G.; Fulmer, C.B.; Halbert, M.L.; Hensley, D.C.; Robinson, R.L.; Snell, A.H.; Westerberg, L.; Sarantites, D.G. 1978.

In Investigation of nuclear structure and nuclear reactions induced by complex projectives. Technical progress report, November 1, 1977—October 31, 1978.

Detailed measurements were made of the first three moments (average, width, and skewness) of the γ-ray multiplicity distributions, in coincidence with the projectile-like fragments and the evaporation residues produced in the bombardment of ^{63}Cu by 165-MeV ^{20}Ne and 130-MeV ^{12}C ions. From those measurements, the angular momentum imparted to the fragments during the collision was determined; comparison is made with current models. The implications of the broad width of the angular momentum distribution following deeply inelastic collisions are discussed. 8 figures, 2 tables. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

RADIOACTIVE DECAY

6969 (LA—7301-PR, pp 14-17) **Delayed neutron emission probabilities for ENDF/B-V.** England, T.R.; Whittemore, N.L. Jun 1978.

In Applied nuclear data research and development. Progress report, January 1—March 31, 1978.

102 delayed neutron branching ratios and half-lives recommended for incorporation in the ENDF/B-V evaluation are tabulated. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6978

6970 (COO—4052-02, pp 21-23) **Gamma-ray multiplicities from reactions forming the compound nucleus ^{100}Ru.** 1978.

In Investigation of nuclear structure and nuclear reactions induced by complex projectives. Technical progress report, November 1, 1977—October 31, 1978.

Deviations from compound-nucleus behavior at lower excitations were studied for excitations of 21.1, 26.9, and 31.7 MeV in ^{100}Ru. Cross sections and multiplicities are shown for the ^{4}He + ^{96}Mo reaction. Statistical-model curves are also presented. 1 figure. (RWR)

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 6969

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

6971 (COO—4052-02, pp 59-61) **Discrete high-spin states in the Yrast sequence of ^{164}Yb.** Johnson, N.R. (Oak Ridge National Lab., TN); Lee, I.Y.; Sugihara, T.T.; Riedinger, L.L.; Bingham, C.R.; Yates, S.W.; Sarantites, D.G. 1978.

In Investigation of nuclear structure and nuclear reactions induced by complex projectives. Technical progress report, November 1, 1977—October 31, 1978.

The reaction ^{150}Nd(^{20}Ne,6n) was used to study ^{164}Yb. A backbending plot shows the variation of the moment of inertia with transition energy; known states up to $J = 22^{+}$ were observed, and three additional transitions were added to the plot as the next three states on the basis of their coincidence and intensity relationships in the yrast sequence. 1 figure. (RWR)

NUCLEAR REACTIONS AND SCATTERING

6972 (COO—4052-02, pp 10-17) **Dependence of γ-multiplicity on transition energy of the continuum from ^{20}Ne + ^{150}Nd reactions.** Sarantites, D.G. (Washington Univ., St. Louis); Westerberg, L.; Geoffroy, K.; Halbert, M.L.; Dayras, R.A.; Benne, J.R.; Hensley, D.C.; Barker, J.H. 1978.

In Investigation of nuclear structure and nuclear reactions induced by complex projectives. Technical progress report, November 1, 1977—October 31, 1978.

The energy depedence is shown for reactions at 115 and 130 MeV. The multiplicity increased slowly up to the midpoint of the end of the yrast bump for the 130 MeV experiment, then decreased to about half the value when the statistical region was reached. 1 figure. (RWR)

6973 (COO—4052-02, pp 17-20) **Evidence for pre-equilibrium effects in ^{16}O + ^{154}Sm fusion reactions.** Geoffroy, K.; Sarantites, D.G.; Halbert, M.L.; Dayras, R.A.; Hensley, D.C.; Barker, J.H. 1978.

In Investigation of nuclear structure and nuclear reactions induced by complex projectives. Technical progress report, November 1, 1977—October 31, 1978.

γ multiplicities and cross sections were measured at 112, 127, 142, 156, and 169 MeV. Total multiplicity and multiplicity to specific exit channels first increase with ^{16}O energy and then level off for the three highest bombardment energies. Saturation effects indicative of pre-equilibrium emission of neutrons and α particles are seen when multiplicity is plotted vs. number of emitted neutrons. 1 figure. (RWR)

6974 (LA—7479-MS) **Fast neutron capture cross sections of ^{169}Tm, ^{191}Ir, ^{193}Ir, and ^{175}Lu for 3 ≦ E/sub n/ ≦ 2000 keV.** Macklin, R.L.; Drake, D.M.; Malanify, J.J. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

Fast-neutron capture cross sections of ^{169}Tm, ^{191}Ir, ^{193}Ir, and ^{175}Lu are presented in tabular form for neutron energies between 3 and 2000 keV. 1 table.

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

6975 (CONF-7805111—1) **Time-dependent Hartree—Fock calculations of Kr-induced strongly damped collisions.** Davies, K.T.R.; Maruhn-Rezwani, V.; Koonin, S.E.; Negele, J.W. (Oak Ridge National Lab., TN (USA); California Inst. of Tech., Pasadena (USA). W.K. Kellogg Radiation Lab.; Massachusetts Inst. of Tech., Cambridge (USA). Center for Theoretical Physics). 1978. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From Workshop on high resolution heavy ion physics at 20-100 MeV/A; Saclay, France (31 May 1978).

The results of a new and potentially definitive test of the time-dependent mean-field approxiation in heavy ion reactions are discussed. In particular the results of a calculation of strongly-damped ^{84}Kr-induced reactions on lead 208 at 494 MeV and on bismuth 209 at 600 MeV using the time-dependent Hartree-Fork approximation are discussed. The experimental Wilczynski plot for the later reaction is shown as well as the results of calculations for 10 impact parameters. 11 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

REFER ALSO TO CITATION(S) 6974

ENERGY LEVELS AND TRANSITIONS

6976 **Search for superheavy nuclei with lifetimes longer than 2ps.** Butler, P.A.; Grodzins, L.; Videbaek, F.; Young, G.R. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science); Diamond, R.M.; Lee, I.Y.; Stephens, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Phys. Lett., B;* **74**: No. 3, 222-224(10 Apr 1978).

The reaction 469 MeV ^{86}Kr + ^{208}Pb was used to search for superheavy elements which decay at rest by fission. The technique searches with equal sensitivity over a lifetime range from 2 ps (the stopping time of the fused system) to many hours and thus covers a broad spectrum of lifetimes not yet examined for superheavy element production. No evidence for such formation was found; the upper limit on the cross section is 1.5 μb.

NUCLEAR REACTIONS AND SCATTERING

6977 (LA—7451-MS) **Gamma spectra from ^{233}U, ^{235}U, and ^{239}Pu during thermal neutron irradiation.** Bendt, P.J.; Jurney, E.T. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

The gamma spectra from three fissionable isotopes, ^{233}U, ^{235}U, and ^{239}Pu, were measured during neutron irradiation in the thermal column of the Omega West Reactor. The measurements were preceded by a neutron irradiation of at least 20,000 s to build up a near-equilibrium concentration of the shorter half-life fission products. The measurements provide the total gamma spectra and do not distinguish between photons emitted following neutron capture, fission, or by fission products. Cross sections were obtained by comparison with the hydrogen (n,γ) peak from a 44.2-mg sample of polyethylene irradiated in the same flux. A 4.7-g/cm^{2} polyethylene scatterer was used to remove fission neutrons from the photon beam. The spectra for all three isotopes are similar, and prominent peaks

occur at the same energies. The spectra can be approximated within approximately 30% by a single exponential: for ^{233}U and ^{235}U, sigma(E) approximately equal to 8000 (exp -1.1 E), and for ^{239}Pu, sigma(E) approximately equal to 11,000 (exp -1.1 E), where E is in MeV. The multiplicity of photons per absorbed neutron, the energy released as gammas per absorbed neutron, and the average photon energy were obtained by summing the photon probability over the spectra.

NUCLEAR THEORY

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 6953, 6982

6978 (LBL—7790) **Nuclear hole states as a probe of the nuclear many body system.** Doll, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

Nuclear hole states studied in proton and neutron pick-up reactions on light and heavy target nuclei exhibit--for deeply-bound shell-model orbits--properties which are strongly affected by target nucleus collectivities. Quasiparticle-like holes in nuclei are formed which show features very similar to those of other highly excited modes, e.g., giant quadrupole resonances. 8 figures.

6979 **Canonical transformations and spectrum generating algebras in the theory of nuclear collective motion.** Gulshani, P.; Rosensteel, G.; Rowe, D.J. pp 3-8 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

In addition to describing quadrupole dynamics, a theory is desired which would also predict or provide the means to observe what goes on inside a rotational nucleus. For this it must be learned what are the relevant quantum mechanical observables that could distinguish between some of the possible flow patterns. These questions and the relations between the phenomenological and microscopic collective models are pursued by making a linear canonical point transformation from particle coordinates to centre-of-mass, collective and intrinsic coordinates. This method is found to provide valuable insights into the interpretation of the algebraic cm(3) model and into its relation with the phenomenological models of quadrupole collective motions. 5 references. (JFP)

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 6953

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6998

6980 (ORO—5126-42) **Unitarity of the Bencze—Redish—Sloan equations.** Polyzou, W. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). May 1978. Contract EY-76-S-05-5126. 10p. Dep. NTIS, PC A02/MF A01.

It is shown that the N-particle scattering equations of Bencze, Redish and Sloan satisfy a proper unitarity relation. The proof uses a recently proposed form of these equations given by Benoist-Gueutal, L'Huillier, Redish and Tandy.

6981 **Failure of the statistical hypothesis for compound nucleus decay.** Chnem, R.E. (Brookhaven National Lab., Upton, N.Y. (USA)). *Nukleonika;* **21**: No. 1, 59-88(1977).

From 9. Masurian school in nuclear physics; Mikolajki, Poland (30 Aug - 11 Sep 1976).

In the past five years, conclusive evidence has accumulated that channel correlations are importent in resonance reactions. Experiments showing the failure of the statistical hypothesis for compound nucleus decay are described. The emphasis is on the radiative neutron capture reaction, where much detailed work has been done. A short summary of the theory of the (n,γ) reaction is presented; it is demonstrated that this reaction is a sensitive probe of the wave functions for highly excited nuclear states. Various experimental techniques using reactor and accelerator-based neutron sources are presented. The experiments have shown that both resonant and non-resonant reactions can show single particle effects where the external part of configuration space is dominant. In the non-resonant case, hard sphere capture is important; on resonances, valence particle motion and the contributions of 1 and 3 quasi-particle doorway states make up a significant fraction of the radiative width.

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 6979

6982 **SP(3,IR) model of nuclear collective motion.** Rosensteel, G.; Rowe, D.J. pp 115-133 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

An algebraic approach is used to incorporate the Bohr--Mottelson model into the microscopic theory of the nucleus. The cm(3) algebraic model is shown to be an algebraic formulation of the Bohr-Mottelson theory. The sp(3,IR) model is derived as the adaptation to the shell model of the Bohr--Mottelson theory. Some applications mentioned are the generation of pure rotational states, rotational-vibrational states, and basis states for conventional shell model calculations with the most realistic microscopic Hamiltonians available. 23 references. (JFP)

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

6983 (LA—7396-M) **MCNP: a general Monte Carlo code for neutron and photon transport.** (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 151p. Dep. NTIS, PC A08/MF A01.

The general-purpose Monte Carlo code MCNP can be used for neutron, photon, or coupled neutron—photon transport. The code treats an arbitrary three-dimensional configuration of materials in geometric cells bounded by first- and second-degree surfaces and some special fourth-degree surfaces (elliptical tori). Pointwise cross-section data are used. For neutrons, all reactions given in a particular cross-section evaluation (such as ENDF/B-IV) are accounted for. For photons, the code takes account of incoherent and coherent scattering, the possibility of fluorescent emission following photoelectric absorption, and absorption in pair production with local emission of annihilation radiation. Standard optional variance reduction schemes include geometry splitting and Russian roulette, the exponential transformation, energy splitting, forced collisions in designated cells, flux estimates at point detectors, track-length estimators, and source biasing. The standard output of MCNP includes two-way current as a function of energy, time, and angle with the normal, across any subset of bounding surfaces in the problem. Fluxes across any set of bounding surfaces are available as a function of time and energy. Similarly, the flux at designated points and the average flux in a cell (track length per unit volume) are standard tallies. Reactions such as fissions or absorptions may be obtained in a subset of geometric cells. The heating tallies give the energy deposition per starting particle. In addition, particles may be flagged when they cross specified surfaces or enter designated cells, and the contributions of these flagged particles to certain of the tallies are listed separately. All quantities printed out have their relative errors listed also. 11 figures, 27 tables.

6984 (ORNL/TM—6515) **Monte Carlo code (PHOEL) for generating initial energies of photoelectrons and Compton electrons produced by photons in water.** Turner, J.E.; Modolo, J.T.; Sordi, G.M.A.A.; Hamm, R.N.; Wright, H.A. (Oak Ridge National Lab., TN (USA)). Sep 1978. Contract W-7405-ENG-26. 15p. Dep. NTIS, PC A02/MF A01.

A Monte Carlo Code, PHOEL, is described for generating the initial energies of Compton and photoelectrons in water irradiated by photons with an arbitrary energy spectrum. An infinite, homogeneous water phantom is assumed in which the photon spectrum is uniform throughout. The neglect of pair production does not represent a significant omission for photons with energies below about 10,000 keV. The code PHOEL was written specifically to provide a source term for a Monte Carlo electron energy degradation and transport code for liquid water being used to study the relative biological effectiveness (RBE) of low-LET radiations at low doses. The basic numerical data used in PHOEL and their mathematical treatment are described as well as the operation of the code. Copies of the program are available from the Radiation Shielding Information Center at Oak Ridge National Laboratory. Some numerical computations which have been made for verification of the code are briefly described. The code processes 1000 photons at 200 keV in less than 2 s on the IBM 360/91. Because of multiple Compton scattering, the processing of higher-energy photons takes somewhat longer. The code has options for printing the electron energies and/or writing them on tape or disc. 1 figure, 2 tables.

6985 (SLAC—210) **EGS code system: computer programs for the Monte Carlo simulation of electromagnetic cascade showers. Version 3.** Ford, R.L.; Nelson, W.R. (Stanford Linear Accelerator

Center, CA (USA)). Jun 1978. Contract EY-76-C-03-0515. 293p. Dep. NTIS, PC A13/MF A01.

A code to simulate almost any electron—photon transport problem conceivable is described. The report begins with a lengthy historical introduction and a description of the shower generation process. Then the detailed physics of the shower processes and the methods used to simulate them are presented. Ideas of sampling theory, transport techniques, particle interactions in general, and programing details are discussed. Next, EGS calculations and various experiments and other Monte Carlo results are compared. The remainder of the report consists of user manuals for EGS, PEGS, and TESTSR codes; options, input specifications, and typical output are included. 38 figures, 12 tables. (RWR)

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 5854, 6983

6986 (COO—2509-7) **Analytical calculations of neutron slowing down and transport in the constant-cross-section problem.** Cacuci, D.G. (Columbia Univ., New York (USA)). 1978. Contract EY-76-S-02-2509. 263p. Dep. NTIS, PC A12/MF A01.

Thesis.

Some aspects of the problem of neutron slowing down and transport in an infinite medium consisting of a single nuclide that scatters elastically and isotropically and has energy-independent cross sections were investigated. The method of singular eigenfunctions was applied to the Boltzmann equation governing the Laplace transform (with respect to the lethargy variable) of the neutron flux. A new sufficient condition for the convergence of the coefficients of the expansion of the scattering kernel in Legendre polynomials was rigorously derived for this energy-dependent problem. Formulas were obtained for the lethargy-dependent spatial moments of the scalar flux that are valid for medium to large lethargies. In deriving these formulas, use was made of the well-known connection between the spatial moments of the Laplace-transformed scalar flux and the moments of the flux in the "eigenvalue space." The calculations were greatly aided by the construction of a closed general expression for these "eigenvalue space" moments. Extensive use was also made of the methods of combinatorial analysis and of computer evaluation, via FORMAC, of complicated sequences of manipulations. For the case of no absorption it was possible to obtain for materials of any atomic weight explicit corrections to the age-theory formulas for the spatial moments M/sub 2n/(u) of the scalar flux that are valid through terms of the order of u^{-5}. The evaluation of the coefficients of the powers of n, as explicit functions of the nuclear mass, is one of the end products of this investigation. In addition, an exact expression for the second spatial moment, $M_2(u)$, valid for arbitrary (constant) absorption, was derived. It is now possible to calculate analytically and rigorously the "age" for the constant-cross-section problem for arbitrary (constant) absorption and nuclear mass. 5 figures, 1 table.

6987 (UCRL—50400(Vol.20)) **Bonderenko self-shielded cross sections and multiband parameters derived from the LLL Evaluated-Nuclear-Data Library (ENDL).** Cullen, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Jul 1978. Contract W-7405-ENG-48. 45p. Dep. NTIS, PC E02/MF A02.

Bonderenko self-shielded cross sections and multiband parameters from the Lawrence Livermore Laboratory Evaluated-Nuclear-Data Library (ENDL) as of July 4, 1978 are presented. These data include total, elastic, capture, and fission cross sections in the TART 175 group structure. Multiband parameters are listed. Bonderenko self-shielded cross section and the multiband parameters are presented on microfiche.

6988 **Existence of complex relaxation lengths in an absorbing medium.** Larsen, E.W. (Los Alamos Scientific Lab., NM). *Transp. Theory Stat. Phys.;* 7: No. 1/2, 25-32(1978).

It is shown that complex relaxation lengths do in fact exist for a rather general type of absorbing medium, and a physical interpretation is provided, assuming isotropic scattering. For a special model transport equation the location of some of these relaxation lengths in the complex plane is described. 15 references. (JFP)

6989 **Mathematical relation between the phase space time evolution method and the neutron transport equation.** Jones, R.B.; Campbell, J.E. (Sandia Labs., Albuquerque, NM). *Transp. Theory Stat. Phys.;* 7: No. 1/2, 33-50(1978).

The neutron transport equation is shown to be analytically related to a quasi-simulation method called the phase space time evolution (PSTE) technique. The analysis establishes the mathematical connection between two apparently different methods of treating particle/wave transport. With this relation known, it is now possible to use quasi-simulation methods for nonphysical particles such as those which obey the adjoint transport equation.

6990 **Information center as a link between basic and applied research.** Pearlstein, S. (Brookhaven National Lab., Upton, NY). *CODATA Bull.;* No. 23, 11-14(May 1977).

From 5. international CODATA conference; Boulder, CO, USA (Jun 1976).

The National Neutron Cross Section Center (NNCSC) concerns itself with neutron physics information of a basic and applied nature. Computerized files of bibliography to the neutron physics literature and of experimental and evaluated neutron data are maintained. The NNCSC coordinates a national effort, the Cross Section Evaluation Working Group (CSEWG), with participants from government, private, and academic institutions, to establish a computerized reference data base Evaluated Nuclear Data File (ENDF/B) for national programs. The ENDF/B is useful to basic research because it contains recommended values based on the best available measurements and is often used as reference data for normalization and analysis of experiments. For applied use, the reference data are extended through nuclear model calculations or nuclear systematics to include all data of interest with standardized processing codes facilitating the use of ENDF/B in certain types of computation. Initially the main application of ENDF/B was power reactor and shield design, and only neutron data were evaluated; but due to the fact that for many applications both neutron and non-neutron data are required, ENDF/B has been extended in scope to include radioactive decay data and radiation spectra for the burnup and after-decay heat of fission products and photon interaction data for gamma ray transport calculations. Cooperation with other centers takes place both nationally and internationally.

MEDICAL PHYSICS

RADIATION PROTECTION STANDARDS

6991 **Clarifying amendments.** *Fed. Regist. (Wash., D.C.);* **43**: No. 131, 29270(7 Jul 1978).

From Energy, 10CFR20, Nuclear Regulatory Commission. Standards for protection against radiation.

When Section 20.103 of the Commission's Standards for Protection Against Radiation was amended recently the amendments did not indicate that radon-222 and its daughters may be averaged over 1 year, as specified in footnote 3 to appendix B of the Standards for Protection Against Radiation. This is clarified by the (amendments set forth below. Minor editorial changes also are made.

6992 **Misadministration reporting requirements.** *Fed. Regist. (Wash., D.C.);* **43**: No. 131, 29297-29298(7 Jul 1978).

From Energy, 10CFR35, Nuclear Regulatory Commission. Human uses of byproduct material.

The Nuclear Regulatory Commission is considering amending its regulations to require licensees to (1) keep records of all misadministrations of radioactive material or radiation from radioactive material, and (2) promptly report potentially dangerous misadministrations to the NRC, to the patient's referring physician, and to the patient or the patient's responsible relative.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 6235, 6243, 6291, 6292

6993 (COO—2407-6) **Kinetics, morphology and thermodynamics of the solid—liquid transition of non-metals. Progress report for period, 1 December 1976—30 November 1977.** Serkerka, R.F.; Hartzell, R.A. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Nov 1977. Contract EY-76-S-02-2407. 22p. Dep. NTIS, PC A02/MF A01.

Modeling of the process of Internal Centrifugal Zone Growth (ICZG) was completed. Both one-dimensional models (for infinitely long samples and induction coils) and two-dimensional models show similar S-curve instabilities on heating, but the two-dimensional models serve to define the shape of the molten zone. Molten zone shape was found to be a sensitive function of rf skin depth in the solid and induction coil geometry. Changes in these parameters lead to zone shapes which change from convex to concave. Practical guidelines were established for the suitability of the ICZG process by calculating a maximum rf frequency to obtain a suitable surface-to-center temperature difference in the sample and a minimum frequency to avoid heating instabilities. For there to be an allowable frequency range, it is necessary that 2hR/sub s//k greater than 1, where h is the surface heat transfer coefficient, R/sub s/ is the sample radius, and k is its thermal conductivity; this limits ICZG to poor conductors (nonmetals), except for very large samples and forced surface cooling. Experiments on silicon were used to verify the heating instability quantitatively. Internal susceptors were tried

to heat oxides at low frequencies but led to local overheating and cracking. 2 figures, 2 tables.

SOLID STATE PLASMA

6994 Far-infrared absorption by electron-hole drops in germanium. Timusk, T.; Zarate, H.G. (McMaster Univ., Hamilton, Ont.). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 324-329(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

We report here on new measurements of the far-infrared resonance absorption of electron-hole drops in the region of 1.5 to 50 MeV, at 1.2°K. The absorption consists of a broad asymmetric line peaking at 9.3 MeV, with a threshold at (2.9 +- 0.1) MeV and a cutoff at (43 +- 2) MeV. The observed lineshape is in excellent agreement with the results of recent theoretical calculations by Rose et al., that include the effect of interband transitions between the heavy and light hole bands. For very small excitation levels an additional broadening due to scattering with the surface has been observed.

SUPERCONDUCTIVITY

REFER ALSO TO CITATION(S) 6233

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 6236, 6266

6995 Inhomogeneous superconductors. Tinkham, M. (Harvard Univ., Cambridge, MA). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 40, 130-142(1978). (CONF-770925—).

From Electrical transport and optical properties of inhomogeneous media conference; Columbus, OH, USA (7 Sep 1977).

The coherence length xi and penetration depth lambda set the characteristic length scales in superconductors, typically 100 to 5,000 A. A lattice of flux lines, each carrying a single quantum, can penetrate type II superconductors, i.e., those for which kappa identical with lambda/xi $> 1/\sqrt{2}$. Inhomogeneities on the scale of the flux lattice spacing are required to pin the lattice to prevent dissipative flux motion. Recent work using voids as pinning centers has demonstrated this principle, but practical materials rely on cold-work, inclusions of second phases, etc., to provide the inhomogeneity. For stability against thermal fluctuations, the superconductor should have the form of many filaments of diameter 10 to 100 μm imbedded in a highly conductive normal metal matrix. Such wire is made by drawing down billets of copper containing rods of the superconductor. An alternative approach is the metallurgical one of Tsuei, which leads to thousands of superconducting filamentary segments in a copper matrix. The superconducting proximity effect causes the whole material to superconduct at low current densities. At high current densities, the range of the proximity effect is reduced so that the effective superconducting volume fraction falls below the percolation threshold, and a finite resistance arises from the copper matrix. But, because of the extremely elongated filaments, this resistance is orders of magnitude lower than that of the normal wire, and low enough to permit the possibility of technical applications.

THEORETICAL PHYSICS

GENERAL AND MISCELLANEOUS

6996 Poincare group generators associated with irreducible unitary representations of space. Beckers, J.; Jaspers, M. pp 455-461 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977). (In French)

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The purpose of this presentation is to obtain new forms of the generators associated with the rotations (vector J) and with the pure Lorentz transformations (vector K) (the generators P/sup μ/ associated with diagonal translations), forms which are simply related to others by means of simple unitary transformations and which have a certain interest in connection with the corresponding operators established in the framework of the representations of light. 16 references. (JFP)

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 6873, 6944

6997 (UCRL—52512) Afton revisited: an improved algorithm for numerical solution of initial value problems in continuum mechanics. Part I. The one-dimensional equations. Glenn, L.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jul 1978. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

The AFTON code calculates the motion of a bounded continuum, or collection of continua, in an arbitrary, time-dependent coordinate system. The complete set of finite-difference equations for the revised and improved version is presented, as well as details of the revisions and a partial bibliography of applications.

6998 Quantization of the damped harmonic oscillator. Feshbach, H.; Tikochinsky, Y. (Massachusetts Inst. of Tech., Cambridge). *Trans. N.Y. Acad. Sci.;* 38: 44-53(4 Nov 1977).

A quantum theory of damped harmonic oscillators is developed in which the details are not explicitly described, but rather their effects are included through parameters such as viscosity whose values can be determined from experiment and then compared with predictions from microscopic theory. Five references (JFP)

6999 Concept of a kinematical stability group in implementing relativistic symmetry. Biedenharn, L.C.; van Dam, H. pp 419-431 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The concept of a kinematical stability group is discussed, which, for an arbitrary four-momentum organized the set of p irreducible representations coherently into an irreducible representation of a larger symmetry group. In terms of a no-go theorem, such a larger symmetry is implementable only as an infinite dimensional group. These ideas arose through an attempt to understand and interpret Dirac's positive energy relativistic wave equation. It was found that the Dirac construction could in fact be viewed as a form of a positive energy relativistically covariant oscillator. This led to the concept of a kinematic stability group. 27 references. (JFP)

7000 Group theoretic aspects of conservation laws of nonlinear time evolution equations: the KdV equation and the cubic Schrodinger equation. Kumei, S. pp 577-584 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

A few results are presented of a study of group theoretic properties of time evolution equations. The aim is to understand clearly a group theoretic meaning of the conservation laws associated with nonlinear equations describing wave propagation. 5 references. (JFP)

7001 Projective irreducible unitary representations of the Schrodinger group with a nontrivial factor. Perroud, M. pp 643-647 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

A classification and a realization are given of the projective irreducible unitary representations of the Schroedinger group which have a nontrivial factor, i.e., representations which are not equivalent to true representations. The connection between some of these representatives and the realizations found previously on spaces of solutions of Schroedinger equations is then established. 6 references. (JFP)

RELATIVITY AND GRAVITATION

7002 Supergravity. Freedman, D.Z. (California Inst. of Tech., Pasadena). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 43, 65-75(1978). (CONF-771089—).

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

The subject of supergravity is reviewed with emphasis on a nontechnical discussion of its achievements, prospects and difficulties. The unification of gravitation with lower spin fields is stressed, and the best present phenomenological application is discussed. Recent results are surveyed briefly. 20 references.

7003 Complex space—times with null strings. Plebanski, J.F.; Robinson, I. pp 231-240 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

Taking as a starting point the definition of surfaces as intersections of u(x/sup μ/) = constant, v(x/sup μ/) = constant, and thought of as the congruence of null strings, i.e., assuming only the complex Einstein vacuum equations in V_4 and the conformal curva-

ture at least minimally degenerate from one side, the Einstein equations are integrated in all remaining generality. Success in this task is reported. 11 references. (JFP)

7004 U(n,n) and generalized twistors. Bacry, H. pp 255-260 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

A pedagogical introduction is given to twistor theory in a slightly more general version and without the use of dotted and undotted indices. Twistors have been introduced previously in relation to general relativity, conformal group, and massless particles. 7 references. (JFP)

7005 Supersymmetry and the hope for a non-trivial fusion between internal and space—time symmetries. Ktorides, C.N. pp 329-335 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

A slightly different way of extending the supersymmetry formalism which includes quite naturally both the gravitational and nonabelian gauge fields is proposed. The method is to construct a fibre bundle over the supersymmetry space with the structural group SU(n). The group SU(n) admits a natural metric which is the Cartan--Killing form; therefore, one can construct a Riemannian metric over the fibre bundle. Introducing the connection in the fibre bundle compatible with this metric, the analog of the Yang-Mills theory is obtained. 7 references. (JFP)

MATHEMATICAL PHYSICS

REFER ALSO TO CITATION(S) 6786, 6837, 6921

7006 Hamiltonian approach to the KdV and other equations. Lax, P.D. pp 39-57 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The Hamiltonian formalism is described together with the way it is applied to the Korteweg-de Vries equation as well as to a slight variant of this equation.

7007 Algebraic and geometric methods of quantization of the isotropic harmonic oscillator. Lasocka, M.; Olszewski, J. pp 181-196 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

The algebraic and geometrical methods of quantization of the isotropic harmonic oscillator are compared. 6 references. (JFP)

7008 Geometrical mechanics and Dirac bracket. Marathe, K.B. pp 371-378 of Group theoretical methods in physics. Sharp, R.T.; Kolman, B. (eds.). New York; Academic Press Inc. (1977).

From 5. international colloquium in group theoretical methods in physics; Montreal, Canada (5 Jul 1976).

It is shown that the Dirac bracket is in fact the Poisson bracket with respect to an appropriate symplectic structure. This is done by starting with the geometrical formulation of Hamiltonian dynamics by using the natural symplectic structure on phase space. Integrals of motion obtained by using the action of these groups may be regarded as constraints on the original system. The Dirac bracket formulation is closely related to the structure of the manifold of zeros of these constraints. 6 references. (JFP)

FUSION ENERGY

REFER ALSO TO CITATION(S) 5451

7009 Technology index for plasmaphysics research and fusion reactors. Cumulative index, Volume 11, 1977. Author index, subject index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1977). 273p.

This is the subject and author cumulative index for the Jan. through Dec. 1977 bibliography series. (MOW)

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

REFER ALSO TO CITATION(S) 7020, 7053

7010 (ORNL/TM—6492) **Alpha-driven, steady-state tokamak.** McNally, J.R. Jr. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

A significant net alpha current is to be expected in tokamak reactors and may provide the seed current essential to driving a bootstrap current in a tokamak to permit steady-state operation without the need for pulse transformers except during startup.

7011 Primary electron confinement measurement in a multipole device. Leung, K.N.; Kribel, R.E. (James Madison Univ., Harrisonburg, Va., (USA). Dept. of Phys.); Goede, A.P.H.; Green, T.S. (UKAEA, Abingdon. Culham Lab.). *Phys. Lett., A;* **66**: No. 2, 112-114(1 May 1978).

A method for measuring the magnetic confinement time of the primary ionizing electron in a multidipole system is described.

7012 Electron and ion heating by neutral injection in the DITE tokamak. Axon, K.B.; Gill, R.D.; Hemsworth, R.S.; Hugill, J.; Lomas, P.J.; Paul, J.W.M.; Powell, B.A.; Prentice, R.; Stott, P.E.; Summers, D.D.R. (UKAEA, Abingdon. Culham Lab.). *Nucl. Fusion;* **18**: No. 7, 981-984(1978).

Neutral-injection heating experiments are reported in which an ion temperature increase of 52% and a central electron temperature increase of 75% were observed. It is shown that the rise in electron temperature is consistent with the added neutral-injection power and that the heating occurs without an increase in impurity level in the plasma.

7013 Hydrodynamics of a parametrically absorbing laser plasma in spherical spread. Polyanichev, A.N.; Tikhonchuk, V.T.; Fetisov, V.S. (AN SSSR, Moscow. Fizicheskij Inst.). *Fiz. Plazmy;* **3**: No. 4, 743-751(1977). (In Russian).

A study has been made of the hydrodynamics of a laser-radiation-heated spherical deuterium target at such radiation fluxes when parametric absorption becomes possible. The study is made within the framework of a numerical solution of two-temperature hydrodynamics equations. Use is made of the model where the absorption coefficient is a finite magnitude dependent upon the density of heating radiation and plasma parameters. Primary attention is paid to the comparative analysis of parametric absorption and bremsstrahlung. It is shown that parametric absorption determines completely plasma dynamics at radiation fluxes that exceed the threshold for instability excitation by more than one order of magnitude. The coefficient of heating-radiation energy reflection drops with the pumping flux. The calculations performed enable one to reveal the role of parametric instabilities in the energy balance of a nuclear plasma. The regularities established in calculations agree with experimental results.

7014 Cyclotron heating in short adiabatic traps. Timofeev, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 4, 913-919(1977). (In Russian).

Electron trapping and continuous acceleration in short adiabatic traps are studied. Considering the effect of Coulomb collisions on the acceleration of trapped electrons has shown that "a whistling" phenomenon is possible in this case. Moreover, it has been found that depending on specific conditions the acceleration is likely to be limited by the following factors: nonaccurate equality of the frequency of electromagnetic oscillations to the minimum cyclotron frequency on a given line of force, instability of cyclotron oscillation frequency, relativistic dependence of the cyclotron frequency on the energy of Larmour rotation, the effect of coherent synchrotron radiation and plasma instability. The conditions have been refined.

7015 Plasma heating by high-current relativistic electron beams. Ryutov, D.D. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 284-297 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The following topics are briefly disussed: (1) beam relaxation in an isothermal plasma in a weak magnetic field, (2) the effects of strong turbulence, (3) plasma heating at moderate magnetic fields, and (4) nonisothermal plasma. (MOW)

7016 Nonlinear dynamics of Joule heated toroidal discharges. Cotsaftis, M. (CEA, Fontenay-aux-Roses, France). pp 326-338 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Starting from the complete MHD system (D), it has been possible in the present analysis to reduce this very large system to its dominant subpart (Ds), which drives to first order its dynamics, splitting apart the equilibrium and cinematics of the magnetic surfaces, the impurity cascade dynamics and the ions dynamics, to be analyzed separately. To study the system (Ds) which is yet a complicated nonlinear one, a specific way has been proposed. Instead of using as elsewhere the approximation or expansion techniques which could very well apply to (Ds), due to its parabolic nature, useful for convergence, it has been remarked that (Ds) possesses invariance property through the group of similarities (S_0). During the first phase of the discharge when the temperature profile-concentrates and shrinks whereas the temperature rises up, the boundary effects, as verified on the datas, are not felt by the solution which follows the group invariance property.

7017 Investigation into plasma heating by strong a-c field in the region of the ion cyclotron resonance. Grigor'eva, L.I.; Smerdov, B.I.; Chechkin, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Fiz. Plazmy;* **2**: No. 2, 254-259(Mar 1976). (In Russian).

Diamagnetizm, as well as ion and electron temperature of a hydrogen plasma have been measured, in which high-amplitude oscillations have been resonantly excited in the vicinity of the ion cyclotron resonance. The amplitude of an alternating field in plasma reaches 500 Oe. Under the conditions a fast heating of electrons and ions up to the temperature of 100 eV takes place. On measuring the dependence of the increment of the plasma transverse pressure on the HF-field amplitude it has been found that heating has a threshold character. It is shown that heating can be due to electron and ion scattering on electric-field turbulent pulsations caused by the development of a current instability of plasma in a field of high-amplitude oscillations.

PLASMA DIAGNOSTICS

7018 (PPPL—1466) **Digital multiradian phase display circuit.** Greenberger, A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1978. Contract EY-76-C-02-3073. 10p. Dep. NTIS, PC A02/MF A01.

A synchronous digital circuit has been built for measuring and displaying the total phase difference between a signal and a reference frequency as a function of time. Intended for use with microwave interferometers, the circuit provides a positive output voltage which linearly varies with phase up to 128x 2π radians with a resolution of $+\text{-}2\pi/16$ radians. In the event that preceding circuitry detects a loss of signal, the circuit displays a negative voltage as an indication. Upon return of the signal, it continues processing with the assumption that the interim phase change was less than π radians. An external pulse may reset the displayed phase to $0 +\text{-} 2\pi/16$ radians regardless of the initial phase difference between the signal and reference.

7019 (UCRL—80923) **Design considerations in ultra-fast electron-optical imaging tubes.** Kalibjian, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jun 1978. Contract W-7405-ENG-48. 6p. (CONF-780804—3). Dep. NTIS, PC A02/MF A01.

From 13. congress on high-speed photography and photonics; Tokyo, Japan (20 Aug 1978).

Electron-optical design parameters are investigated with respect to optimizing dynamic range and temporal and spatial resolution in streak- and framing-camera tubes.

7020 Interferometric study of the laser plasma corona under a heating pulse action. Zakharenkov, Yu.A.; Krokhin, O.N.; Pustovalov, V.V.; Silin, V.P.; Sklizkov, G.V.; Starodub, A.N.; Tikhonchuk, V.T.; Shikanov, A.S. (AN SSSR, Moscow. Fizicheskij Inst.). *Fiz. Plazmy;* **3**: No. 4, 733-742(1977). (In Russian).

Based on the examination of interferograms a study has been made of the "opacity" zone in the corona of a laser plasma produced on a target surface by the power 9-channel Nd-laser "Kalmar" whose all nine beams are focused by a common two-component objective onto the target. The following parameters of laser radiation are: energy up to 250 J, half-power pulse duration 1.5 ns, focal spot diameter about 200 μm. It has been found that the opacity zone reaches a maximum dimension in the course of heating laser pulse action. It is concluded that this effect may be explained by the excitation of a nonlocal parametric turbulence. Nonlocality manifests itself through the fact that the turbulence develops within the entire plasma corona from the region of the critical density to the region of a highly rarefied plasma. It has been established that the increase in the size of the opacity zone in several nanoseconds after laser pulse completion, as well as its appearance at small flux densities, is not associated with parametric effects but is caused by spread of a "cold" plasma upon completion of the laser pulse.

PLASMA KINETICS - EXPERIMENTAL

7021 (PPPL—1479) **Comparison of tungsten and gold radiation from beam-foil excitation and tokamak-produced plasmas.** Johnson, B.M.; Jones, K.W.; Cecchi, J.L.; Hinnov, E.; Kruse, T.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1978. Contract EY-76-C-02-3073. 14p. Dep. NTIS, PC A02/MF A01.

Spectra in the 30 to 80 A wavelength region of tungsten and gold ions, with charge states ranging from 20 to 33, and 25 to 38, respectively, have been measured in beam-foil excitation and compared with similar spectra from tokamak-produced plasmas. Several common features are observed. Assignment of observed features to particular states of ionization can be made with greater assurance for the beam foil spectra than for the tokamak spectra due to superior control and predictability of the ion charge states in the beam-foil experiment.

7022 Observations of multiply ionized tungsten radiation in the PLT discharges. Hinnov, E. (Princeton Univ., N.J. (USA). Plasma Physics Lab.); Mattioli, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). *Phys. Lett., A;* **66**: No. 2, 109-111(1 May 1978).

Spectral and spatial distributions of radiation bands with peaks at 33, 51 and 60 A, ascribed to 4d-4f transitions of tungsten ions in the range about W XX-W XXXV, have been measured in discharges of different electron temperatures.

7023 Sequences of neutron and X-ray flashes during a long-lasting current in a plasma focus device. Salge, J.; Braunsberger, U.; Fell, B. (Technische Univ. Braunschweig (Germany, F.R.)); Ueno, I. (Tokyo Univ. (Japan)); Conrads, H. (Association Euratom-KFA, Juelich (Germany, F.R.)). *Nucl. Fusion;* **18**: No. 7, 972-974(1978).

The possibility of increasing the neutron yield of a dense plasma focus by several focus events during a single discharge of an energy store is discussed. On a small focus device supplied with a long-lasting current pulse from an inductive energy store, experiments were carried out where several radiation flashes in rapid succession during one discharge could be observed. By the time-of-flight method the generation of fast neutrons was proved.

7024 Damping reverse current induced by a relativistic electron beam in a plasma. Shkvarunets, A.G.; Krementsov, V.I.; Strelkov, P.S. (AN SSSR, Moscow. Fizicheskij Inst.). *Fiz. Plazmy;* **3**: No. 4, 770-773(1977). (In Russian).

Interaction of a relativistic electron beam (REB) with a plasma is studied in experiment. REB has been injected into a metal drift chamber in a longitudinal uniform field. A uniform plasma column has been performed on the chamber axis. A total current, i.e. a sum of the beam and plasma currents at the beginning and the end of the chamber, a beam current onto a collector, a signal from a beam potential monitor, the density of the plasma column at the instant prior to beam injection have been recorded. It is established that in a comparatively dense plasma (Nsub(p)$>10^{12}$ cm^{-3}) the damping of the back current induced by REB in the plasma is due to the absence of electron emission from the collector. At Nsub(p)$<10^{12}$ cm^{-3} the damping is independent of the collector emissivity and is associated probably with a beam-plasma interaction. A well emitting plasma collector has been created either with the aid of a spark discharge or by REB itself in the interaction with the collector. In the former case at Nsub(p)$>10^{12}$ cm^{-3} the back current has shown no damping, while in the latter case a partial breakaway has been observed.

7025 Runaway electrons in the TM-3 tokamak. Sannikov, V.V.; Sokolov, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **2**: No. 2, 204-211(1976). (In Russian).

The fraction of fast electrons in a low-density plasma, their transverse energy has been quantitatively estimated and the radial distribution of Tsub(e) has been investigated by the Thomson scattering method. Narrow-band detectors have been used for detecting SHF radiation of fast electrons, which has made it possible to estimate the fast electron longitudinal energy as well. The measurements allowed to attribute an increase in Tsub(e) observed earlier to decrease in nsub(e) i.e. to increase of the fraction of runaway electrons. They also provide a possibility of more exact calculation of plasma electric conductivity.

7026 Investigation of possibility of toroidal plasma filament formation in a heliotron poloidal magnetic field. Zykov, V.G.; Karpukhin, V.I.; Lonin, Yu.F.; Lonin, Yu.F.; Rudnev, N.I.; Podteregera, N.N.; Skibenko, A.I.; Fomin, I.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Fiz. Plazmy;* **2**: No. 2, 197-203(1976). (In Russian).

For English translation see the journal Sov. J. Plasma Phys.

The phenomenon of short circuiting of vertical polarization electric fields macroscopic drift of a plasma filament due to depolarization currents closed through plasma localizing at the zero point of

a magnetic field has been experimentally investigated from the viewpoint of its application for forming a toroidal plasma filament. The effect of the average "min H" of the heliotron magnetic field modulation depth on the macroscopic stability and plasma equilibrium in a toroidal magnetic field has been investigated.

PLASMA KINETICS - THEORETICAL

7027 (ANL/FPP—78-1, pp 91-95) **Applied plasma physics.** 1978.

In Fusion Power Program. Quarterly progress report, January—March 1978.

This section briefly describes work on the following areas: (1) disparate clump approximation in neoclassical transport theory, and (2) theoretical spectroscopic data for silver-like ions. (MOW)

7028 (PPPL—1461) **Electrostatic and magnetostatic particle simulation models in three dimensions.** Okuda, H.; Lee, W.W.; Cheng, C.Z. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1978. Contract EY-76-C-02-3073. 24p. Dep. NTIS, PC A02/MF A01.

Electrostatic and magnetostatic particle simulation models have been developed and tested for a magnetically confined plasma near thermal equilibrium. The model makes use of a three-dimensional grid elongated in the direction of a magnetic field to simulate plasma confinement devices. Linear interpolation is used on a two-dimensional grid perpendicular to a magnetic field while quadratic or cubic interpolation is used in the direction of the magnetic field. It is found that the energy conservation is good and the fluctuation spectra for the electric and magnetic fields agree with theoretical predictions. The model presented here may be used as an alternative method to simulate a laboratory device along with the hybrid model which makes use of the combination of a two-dimensional spatial grid and an eigenfunction expansion along the main magnetic field.

7029 **Ambipolarity paradox in toroidal diffusion, revisited.** Hirshman, S.P. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). *Nucl. Fusion;* **18**: No. 7, 917-927(1978).

The radial current in an axisymmetric toroidal plasma is shown to damp away because of parallel ion viscosity on the ion-ion collision time scale. After this transient phase, the electrostatic potential is quasi-statically related to the toroidal angular momentum of each flux surface, and the cross-field particle fluxes are ambipolar and independent of the radial electric field.

7030 **Two-component, multiple-mirror reactor with depressed ion temperature.** Yang, S.T.; Lieberman, M.A. (California Univ., Berkeley (USA). Electronics Research Lab.). *Nucl. Fusion;* **18**: No. 7, 965-969(1978).

The power balance equations for a two-component multiple-mirror reactor have been solved. The electron- and warm-ion-component power flows are treated separately. Significant depression of the ion temperature is found, slowing the multiple-mirror losses. For P (net electrical)=P(beam), a typical calculated reactor length is 230m for a midplane field of 9.3T.

7031 **Surface impedance of a plasma cylinder in case of anomalous skin effect.** Bobrov, Yu.G. *Zh. Tekh. Fiz.;* **47**: No. 6, 1199-1204(Jun 1977). (In Russian).

The theory of the anomalous skin effect in a plasma cylinder proposed earlier by the author is used for a quantitative estimation of the electromagnetic field energy dissipation in a plasma under the conditions of the anomalous skin effect-"anomalous" absorption. Given the static conductivity of the plasma, the active component of the surface impedance is shown to increase with the electron free path length and to exceed multiply this component for the normal skin effect. The results of calculations depicted graphically show that the anomalous skin effect leads to an essential growth of the electromagnetic field energy absorption by the plasma. The parameters defining the "anomalous" absorption are functions of the electron temperature and density and can be calculated, provided their values are known. In this case the energy lost in the plasma and also the active and reactive loads which it introduces into a high-frequency circuit can be determined.

7032 **Numerical simulation of plasma equilibrium at a tokamak taking account of saturation effects of ferromagnets.** Bondarchuk, Eh.N.; Doinikov, N.I.; Mingalev, B.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). *Zh. Tekh. Fiz.;* **47**: No. 3, 521-526(Mar 1977). (In Russian).

The MHD approximation was applied to the technique of numerical simulation of the equilibrium of a quasistationary axisymmetric plasma with an arbitrary section in the presence of a ferromagnet. Tokamak regime with a different distributions of a longitudinal current was the subject of simulation. Current-voltage dependences were obtained in a system of a poloidal field. The results obtained point to the efficiency of the numerical simulation being applied to the problem of plasma equilibrium. The calculations were performed by a slightly modified technique proposed earlier for the study of permanent electromagnet fields. Of some interest is the determination of the magnetic system currents in the process of iterations. The simulation of the complete time cycle with the use of 32x24 square net took 15-20 hrs on the computer BESM-4.

7033 **Plasma physics: nonlinear theory and experiments.** Wilhelmsson, H. (ed.). New York; Plenum Press (1977). 525p. (CONF-760635—). $39.50.

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Separate abstracts were prepared for 29 of the included papers. Abstracts for the remaining papers appeared previously in ERA. (MOW)

7034 **Non-linear effects in plasmas.** ter Haar, D. (Magdalen Coll., Oxford). pp 1-8 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

An introductory review of nonlinear theories is given. Renormalization theories and nonlinear density waves in plasmas are considered in particular. (MOW)

7035 **Modulation instability and strong Langmuir turbulence.** Tsytovich, V.N. (Levedev Inst. of Physics, Moscow). pp 166-187 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The problems analyzed include the theoretical description of Langmuir condensation of strong nonlinear motions in nonequilibrium plasmas and the statistical theory of strong Langmuir turbulence.

7036 **Utilization of the formalism of Lagrangian variables for the investigation of some nonlinear plasma physics problems.** Kovriznych, L.M. (Lebedev Inst. of Physics, Moscow). pp 241-261 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Some nonlinear problems of plasma physics are considered using the one-dimensional equations of motion in Lagrangian variables. (MOW)

7037 **Neutral atom balance in plasma of tokamak-4.** Izvozchikov, A.B.; Petrov, M.P. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). *Fiz. Plazmy;* **2**: No. 2, 212-218(1976). (In Russian).

The problem has been formulated and the results of numerical calculation of the balance of operating gas neutral atoms for two typical regimes of the Tokamak-4 discharge (deuterium and hydrogen) have been presented. The distribution of atom density over the plasma filament section and the energy distribution of the recharging atom flux from the plasma have been calculated for the regimes. A comparison of the atom flux distribution calculated with that measured experimentally at the Tokamak-4 has made it possible to obtain the absolute distribution of the atom density over the plasma filament section and to evaluate integral losses of the plasma filament energy in charge exchange. On the basis of the above calculations and comparison it has been concluded that the resonance change exchange is not the main channel of energy losses from the plasma in the Tokamak-4.

7038 **Accelerated electron beam instability in a tokamak.** Parail, V.V.; Pogutse, O.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **2**: No. 2, 228-236(1976). (In Russian).

The theory of instability observed at tokamaks in low-density regimes when there is a beam of accelerated electrons has been developed. The instability has been shown to arise due to build-up of oscillations on the Doppler anomalous effect and to lead to redistribution of beam particles over transverse velocities. A system of nonlinear equations has been obtained for transverse and longitudinal energy of beam particles and for oscillation energy by applying the quasilinear theory. The system describes the relaxation oscillations, whose properties are in a qualitative agreement with those of oscillations observed in the experiment.

PLASMA PRODUCTION

7039 (LA—7410-MS) **Hybrid method for the numerical solution of the electron transport equation: the reduced source method.** Fraley, G.S.; Lee, K.; Stroscio, M.A. (Los Alamos Scientific Lab., NM (USA)). Aug 1978. Contract W-7405-ENG-36. 12p. Dep. NTIS, PC A02/MF A01.

The problem of correctly transporting the suprathermal electrons produced in laser-plasma interactions is complicated by the

fact that the suprathermal mean free path varies over approximately ten orders of magnitude for typical laser fusion conditions. The reduced source method (RSM) offers a means of treating transport under such conditions. We derive the reduced source for the special case where the initial distribution is determined by multigroup diffusion. This special case represents an unnecessary restriction on the application of RSM to suprathermal electron transport.

7040 Limitations for the generation of GeV ions from laser irradiated targets. Hora, H.; Kane, E.L.; Hughes, J.L. (New South Wales Univ., Kensington (Australia)). *Nucl. Instrum. Methods;* **150**: No. 3, 589-592(15 Apr 1978).

The short range shrinking of a laser beam in a solid target to approximately a wavelength diameter by relativistic self-focusing, generates laser intensities which accelerate highly charged ions to MeV energies in agreement with experiments. Limitations at higher energies due to high-Z ionization and the Debye length as well as depletion by nonlinear radiation (ponderomotive) forces are given.

7041 Investigations of RPI in dynamic gas conditions. Grizinski, M.; Nowikowski, L. (Institute of Nuclear Research, Warsaw (Poland)). *Nukleonika;* **21**: No. 11, 1225-1236(1976).

In the paper the results of recent investigations on a new type plasma injector (RPI) are presented. The high speed camera observations, voltage-current characteristics and X-rays measurements shown that the further improvement in the device construction has been achieved.

PLASMA INSTABILITIES

7042 Suppression of the dense plasma flute instability in an open trap by means of feedback system adjusting collisionnal losses of electrons behind mirrors. Arsenin, V.V.; Chuyanov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **2**: No. 2, 244-247(1976). (In Russian).

For English translation see the journal Sov. J. Plasma Phys.

Stabilization of flute disturbances of plasma contained in a trap with a simple mirror field has been considered by means of an automatic control of the potential difference between plasma and sectionalized "trans-mirror" wall. It has been shown that by a slight variation of the sigma PHI wall potential, proportional to a potential disturbance in sigma phi plasma, it is possible to affect collisional withdrawal of electron outside mirrors, compensate convective storage (separation) of a charge in plasma and suppress thus the flute instability. The sigma PHI/sigma phi ratio required for stabilization is proportional to the time of ion containment in the trap, and in the case of microinstabilitiy suppression it decreases with density increase. Therefore the method is mainly appropriate for stabilizing the "thermonuclear" plasma.

7043 Evolution of stimulated Brillouin to stimulated ion Compton scattering in a CO_2 laser-plasma interaction experiment. Offenberger, A.A.; Ng, A.; Cervenan, M.R. (Alberta Univ., Edmonton (Canada). Dept. of Electrical Engineering). *Can. J. Phys.;* **56**: No. 3, 381-386(Mar 1978).

13 refs.

Strong backscatter (> approximately 20%) has been observed in the interaction of focused CO_2 laser radiation (I approximately 10^{12} W/cm^2) with a hydrogen gas target plasma. Spectral measurements show it to arise from stimulated ion Compton scattering (SCS) at later times when the electron-ion temperature ratio is not large. The scattering growth rate γ was determined experimentally to be 3.4×10^{12} s^{-1}, in good agreement with theoretical predictions for our plasma parameters. Temporal modulation of the backscatter clearly shows build-up and decay of SCS durng the interaction time. It may be anticipated that such scattering will be important in laser-pellet fusion experiments.

7044 Experimental transfer function analysis of a dissipative and a reactive mode. Grubb, D.P.; Emmert, G.A. (Wisconsin Univ., Madison (USA)). *Nucl. Fusion;* **18**: No. 7, 977-981(1978).

Experimental measurements of the transfer function of both a dissipative and a reactive instability in the same device - the Linear Multi-Mirror experiment - are reported. The results illustrate clearly the dissipative and reactive nature of each mode and are consistent with the theoretical form of the transfer function.

7045 Tearing-mode-stable diffuse-pinch configurations. Robinson, D.C. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.). *Nucl. Fusion;* **18**: No. 7, 939-953(1978).

It is demonstrated that tearing-mode-stable diffuse-pinch configurations of the reverse-field pinch type exist at zero β for a current-carrying column surrounded by a small vacuum region. The conducting wall plays a vital role in this stability both to m=0 and m=1 modes. The core of the plasma, which has to satisfy a resistive-stability criterion, is of the form given by Taylor for a minimum-energy state but the outer region is quite different. Values of the pinch configuration parameter theta up to 3 are possible, permitting strong Ohmic heating with zero or low current densities near the wall. Such configurations can be stable to ideal hydromagnetic modes for central values of β of up to 17% (average β 35%).

7046 Cyclotron oscillations of a large-Larmor-radius plasma. Timofeev, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Nucl. Fusion;* **18**: No. 7, 955-963(1978).

A method is proposed for investigating plasma oscillations in axially symmetric systems with a longitudinal magnetic field, which can be used for an arbitrary ratio of the Larmor radius of charged particles to the radius of the system. An anisotropic ion cyclotron instability and a modified negative-mass instability are analysed with this method. The analysis was performed for a system with parameters similar to those of the Ogra-3 device. It is shown, in particular, that in the case of a modified negative-mass instability, the threshold density for oscillations of the first azimuthal mode has a lower value than for the zero mode. This result corresponds to experimental data.

7047 Langmuir wave collapse in a magnetic field. Krasnosel'skikh, V.V.; Sotnikov, V.I. (AN SSSR, Moscow. Inst. Khimii Prirodnykh Soedinenij). *Fiz. Plazmy;* **3**: No. 4, 872-879(1977). (In Russian).

The dynamics of a modulation instability is studied in plasma in a magnetic field satisfying the condition 1>> ωsub(H)sup(2)/ ωsub(p)sup(2) > or approximat Ksub(O)sup(2) rsub(D)sup(2), where ωsub(H), ωsub(p) are the cyclotron and Langmuir frequencies respectively, K_0 is the characteristic wave number in the spectrum, rsub(D) is the Debye length. Nonlinear equations describing the modulation instability have been obtained. They are used to consider a linear stage of the modulation instability and it is shown that a fairly strong magnetic field results in the fact that the instability develops in a narrow cone of angles α approximately ωsub(p)/ ωsub(H)Ksub(0)rsub(D), the cone axis being along the pumping wave. As a result cavernes appearing in the magnetic field, take the form of "pancakes" constricted in the direction of the pumping wave, coincided with the direction of the magnetic field. It is shown that in the conditions under investigation a collapse of the cavernes is possible, and similar solutions have been obtained describing the "explosive" growth of the field and amplitude of density variation in a caverneon collapse.

7048 Ionization instability of a plasma in a laser radiation field. Nastoyashii, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). *Fiz. Plazmy;* **3**: No. 4, 752-757(1977). (In Russian).

The problem of ionization state stability in a laser heated plasma is discussed. It is shown that under certain conditions in plasma there may appear instability that produces plasma lamination with different temperatures and ionization multiplicity in layers. Simplified models have been used to determine the instability limits and disturbance buildup rate. Consideration is given to a nonlinear solutions of the corresponding one-dimensional problem on temperature and ionization distribution in unstable plasma.

7049 Experiments on parametric instabilities in laser-plasma interactions. Chen, F.F. (Univ. of California, Los Angeles). pp 82-101 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

A survey of relevant experiments is presented. A comparison was made of laser-plasma source combinations. (MOW)

7050 Coupling saturation in the nonlinear theory of parametric decay instabilities. DuBois, D.F.; Bezzerides, B. (Los Alamos Scientific Lab., NM). pp 122-141 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The nonlinear equations describing decay instabilities are derived starting from the susceptibility expansion of the nonlinear Poisson equation. The theory is applied to the 2ω/sub Pe/ (electron-electron) decay instability. We find that coupling saturation dominates the mechanism of induced scattering from ions producing a much lower wave level than previous estimates. The electron-ion decay instability is considered for T/sub e/ >> T/sub i/. The coupling saturation mechanism strongly limits the wave energy in the most favorably matched mode for strong pump amplitudes. This mode in turn drives further decay instabilities spreading the spectrum to lower [vector k]. The total wave energy in a one-dimensional model increases as E_0/sup $^4/_3$/ for sufficiently strong pump intensities E_0, whereas if coupling saturation is neglected the power law is E_0^4.

7051 Cross-field anomalous resistivity associated with the lower-hybrid-drift instability in strongly inhomogeneous plasmas. Davidson, R.C. (Univ. of Maryland, College Park). pp 305-325 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The cross-field anomalous resistivity associated with the lower-hybrid-drift instability is investigated. Particular emphasis is placed on the low-drift-velocity regime characterized by r/sub Li// 2ΔL/sub n/< or approximately 1, where r/sub Li/ = v/sub i//ω/ sub ci/ is the ion Larmor radius, and ΔL/sub n/ = -(delta lnN/delta x)$^{-1}$ is the length scale for density inhomogeneity.

7052 Temporal evolution of plasma density fluctuations in the presence of a strong electromagnetic wave. Piliya, A.D. (Ioffe Inst. of Physics and Tech., Leningrad). pp 339-347 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

An instability driven by the pump wave is considered. Typical wave trajectories are given for: (1) before the conversion conditions are reached, and (2) at the stage of the wave conversion. (MOW)

7053 Parametric decay processes and heating in a bounded magnetized plasma. van Oost, G.; Bhatnager, V.P.; Messiaen, A.M.; Paithanker, A.S.; Vandemplas, P.E. pp 377-394 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Parametric interactions are studied on the present plasma set-up characterized by the presence of many normal modes, previously investigated in a small-signal study. Two types of resonant parametric instabilities have been simultaneously observed above a certain threshold of the pump power at frequency f/sub p/(f/sub LH/ < f/ sub p/ << f/sub pe/). In both processes the electron decay product is a Trivelpiece-Gould (TG) mode. In the first type the ion decay is an ion-acoustic (IA) wave (f < f/sub ci/) and electron and ion heating are observed. In the second type the ion decay mode is an ion-cyclotron (IC) wave (f/sub ci/ < f < f/sub pi/) the spectral width of which is much larger than that of the IA spectrum and it is only accompanied by electron heating. All decay modes have been identified after careful comparison with the results of the study of the linear wave resonances of the system. Enhanced diffusion is furthermore observed.

7054 Flute oscillations in a noncompensated plasma. Gribkov, V.M. (Moskovskij Gosudarstvennyj Univ. (USSR). Fizicheskij Fakul'tet). *Fiz. Plazmy;* **2**: No. 2, 319-326(1976). (In Russian).

The problem on the stability of flute oscillations in a rarefied uncompensated plasma in a magnetic field of the simple mirror geometry is considered. The spectrum of eigen values of the boundary value problem for the differential equation describing the flute oscillations of the first and second radial modes has been obtained by numerical methods. The spectrum of eigen frequencies obtained has been found to be beyond limits singularity possible regions of the equation under consideration which corresponds to position of resonance points of the problem outside the plasma boundaries. The calculated increments of the flute oscillations make it possible to construct the upper density limits of the instability region for different noncompensations. A set of the eigen function profiles of the problem has been obtained for the first and second radial modes in a wide range of the parameters.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 7043, 7047

7055 Strong Langmuir turbulence. Rudakov, L.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii); Tsytovich, V.N. (Lebedev Institute of Physics, Moscow, USSR). *Phys. Rep.;* **40**: No. 1, 1-73(Apr 1978).

This review attempts to present an overview of some recent approaches to the theory of strong Langmuir turbulence. A large amount of space is devoted to modulational instability processes, both for the case where the plasma is pumped by a monochromatic wave, and for the case when there is a broad-band incoherent pump. The properties of Langmuir solitons are discussed in some detail, especially for the one-dimensional case, presenting results both from analytical studies and from computer experiments. Three-dimensional cavitons are also discussed. Another topic dealt with in some detail is that of statistical approaches to strong turbulence. As this field is still in a state of rapid development, some of the conclusions are necessarily tentative and preliminary.

7056 Non-resonant pump field modification of the sidescatter threshold. Guzdar, P.N. (Princeton Univ., N.J. (USA). Plasma Physics Lab.); Sen, A. (Physical Research Lab., Ahmedabad (India)). *Nucl. Fusion;* **18**: No. 7, 970-971(1978).

The modification of the dispersion relation for the ion acoustic wave in the presence of an electromagnetic pump wave obliquely incident on the plasma is studied. Furthermore, its effect on the Brillouin sidescatter threshold is examined.

7057 Parametric excitation of nonlinear longitudinal oscillations in a magnetoactive plasma. Demchenko, V.V. *Izv. Vyssh. Uchebn. Zaved., Radiofiz.;* **20**: No. 10, 1479-1488(1977). (In Russian).

Parametric excitation by HF field of nonlinear longitudinal electron oscillations in the region of hybrid resonances of a cold nonrelativistic plasma has been investigated. It is shown that the inhomogeneity of a pumping field and that of the equilibrium plasma density result in the parametric instability. Expressions are derived for the increments of instable oscillations and the widths of the instability regions are determined. The increments of instable oscillations in the order of magnitude due to the inhomogeneities of the pumping field (γsub(E)) or of the plasma density (γsub(N)) are egual to γsub(E) approximately k(zetasub(0)) ωsub(pe), γsub(N) approximately (zetasub(0))/Lωsub(pe), where (zetasub(0))=(e)Esub(0)/ msub(e)ωsub(0)sup(2) is the amplitude of displacement of an electron from the equilibrium state, k, ω_0, E_0 are the wave number, frequency and amplitude of the pumping field, L is the characteristic size of the inhomogeneity of the plasma density, ωsub(pe) is the electron plasma frequency.

7058 Detection of plasma waves in a turbulent plasma from satellites of helium forbidden transitions. Eremin, B.G.; Kostrov, A.V.; Lunin, N.V.; Stepanushkin, A.D. (Gor'kovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Radiofizicheskij Inst.). *Izv. Vyssh. Uchebn. Zaved., Radiofiz.;* **20**: No. 10, 1489-1492(1977). (In Russian).

Plasma wave excitation under intensive electromagnetic irradiation of collisionless plasma is determined from the satellites of helium forbidden transitions. 4'D-2'P(lambda=4922 A) allowed transition and 4'F-2'P forbidden transition were used for measurements. The helium plasma (Tsub(e) approximately 100eV, Tsub(i) approximately 1eV) is formed by an inductive spark gap at approximately 10^{-2} Torr. It has been found that plasma waves formed due to parametric instability evolution have the electric field amplitude considerably higher than that of the pumping wave. Plasma wave excitation is accompanied by fast electron generation. From the analysis of the curves obtained it is seen, that the plasma wave excitation and fast electron generation practically coincide.

7059 Electromagnetic wave nonlinear penetration in a magnetoactive semibounded plasma. Pavlenko, V.N.; Revenchuk, S.M. (AN Ukrainskoj SSR, Kiev. Inst. Fiziki; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). *Fiz. Plazmy;* **3**: No. 4, 815-823(1977). (In Russian).

The kinetic approximation is used to consider the problem of penetration into a semibounded magnetoactive plasma (a stationary and uniform magnetic field being perpendicular to the plasma plane boundary) of electromagnetic waves due to their nonlinear interaction in the case of a normal (to the plasma boundary) wave propagation. It is shown that the two electromagnetic waves with the frequencies ω_1 and ω_2 excite in the plasma nonlinear longitudinal oscillations at the combination frequencies $\omega=\omega_2+-\omega_1$. Consideration is given to the case when the frequencies ω_1 and ω_2 are in the band of the resonance electron-cyclotron absorption, and the nonlinear oscillations on the added and difference frequencies are weakly decaying Langmuir and ionacoustic oscillations respectively. From the viewpoint of plasma heating most interesting is the case of the excitation of nonlinear longitudinal ion-acoustic oscillations transferring their energy to the plasma ion component.

7060 Interaction of coherent waves with a magnetohydrodynamic turbulence. Pimenov, S.F.; Sinitsyn, Yu.A. (AN Ukrainskoj SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki). *Fiz. Plazmy;* **3**: No. 4, 805-814(1977). (In Russian).

Magnetohydrodynamic approximation is used to consider the interaction of coherent waves with the Kolmogorov type turbulence. A self-consistent equation system has been obtained, composed of a dynamic equation for waves and kinetic type equations describing the turbulence. Such an approach makes possible in the linear approximation to the wave amplitude to allow in the lower order for the processes of coherent wave - turbulence interaction. The equations have been used for calculation of the attenuation decrements of the long waves interacting with the Kolmogorov's turbulence.

7061 Electromagnetic wave propagation through a plasma sheath produced by a moving ionization source. Semenova, V.I. (Gor'kovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Radiofizicheskij Inst.). *Fiz. Plazmy;* 3: No. 4, 824-831(1977). (In Russian).

Features of the interaction of electromagnetic waves are considered with a nonstationary plasma layer of a finite thickness, produced in an immovable gas by a movable ionization source. It is shown that a static magnetic field excited on the ionization front in build-up of electrons produced in the incident wave field reemits the energy to the electromagnetic wave during the plasma relaxation caused by recombination processes. As a result the electromagnetic wave of a finite amplitude may propagate behind the nonstationary layer of an "opaque" (ωsub(p)sup(2)>>ωsub(urc)sup((0))sup(2)) plasma as distinct from the layer of a movable stationary plasma with the same parameters.

7062 Parametric excitation of longitudinal oscillations by a transverse - longitudinal field generated by two shf waves in a plasma. Zyunder, D. (Inst. Ehlektronnoj Fiziki (DD)); Tskhakaya, D.D. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). *Fiz. Plazmy;* 3: No. 4, 865-871(1977). (In Russian).

Theoretical treatment is given to the effect of two external SHF waves with the frequencies $\omega_1,\omega_2 >> \sqrt{}$sub(Le) on plasma. One of the waves is supposed to be much weaker than the other and the difference requency - much lower than ω_2, ω_1. The Lorentz magnetic force caused by transverse SHF waves leads to the appearance of longitudinal field with the frequency ω_3. Under certain conditions the longitudinal component of the pumping field in the plasma may result in a more effective amplification of the plasma intrinsic longitudinal oscillations than the transverse field of the SHF waves. The expression is given for the wave increment together with the expression for the threshold value of the modulation depth.

7063 Multiple wave interaction and harmonic generation in laser created plasmas. Bobin, J.L. (CEA, Villeneuve-Saint-Georges, France). pp 102-121 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The mechanisms leading to harmonic generation in inhomogeneous laser created plasmas are reviewed. After a description of classical and three-quanta processes, the role of Raman up-conversion is emphasized. The limitations due to the selection rule on k vectors are stated. In many cases the only way of getting rid of them comes from four wave processes. These have also the advantage of accounting for the asymetric broadening of the 2ω/sub L/ and 3ω/sub L//2 harmonics. Theoretical results are compared to experimental data. Finally, the use of harmonic and subharmonic generation for laser plasma interaction and laser induced plasma flow diagnostics is discussed.

7064 Variation principle for nonlinear wave propagation. Watanabe, T.; Lee, Y.C.; Nishikawa, K. (Hiroshima Univ.). pp 142-151 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

A simple but general expression is derived for the pondermotive force acting along the magnetic field. Using the charge neutrality for the static part of the density, a relation is derived which determines the self-consistent density profile in terms of the oscillating variables. The variation principle is derived from Maxwell's equations. A brief discussion is given on the kinetic effects and on the validity of the present formalism. (MOW)

7065 Three-wave coupling coefficients for magnetized plasmas. Stenflo, L.; Larsson, J. (Umea Univ., Sweden). pp 152-158 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

A general expression for three-wave coupling coefficients is considered. Its application to four specific examples is illustrated. (MOW)

7066 Macroscopic consequences of the Langmuir waves collapse. Galeev, A.A.; Sagdeev, R.Z.; Shapiro, V.D.; Shevchenko, V.V. (Inst. of Space Research, Moscow). pp 188-201 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Equations describing the energy flow into plasma caverns due to modulational instabilities are discussed. An analysis is given for the relaxation of electron beams entering a cold plasma. (MOW)

7067 Langmuir solitons and ion-sound. ter Haar, D. (Magdalen Coll., Oxford). pp 202-210 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

This theoretical analysis is restricted to the one-dimensional case and only occasionally refers to what happens in the three-dimensional case. (MOW)

7068 Langmuir solitons and resonance absorption in laser-irradiated plasmas. Chen, H.H.; Liu, C.S. (Univ. of Maryland, College Park). pp 211-221 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Nonlinear Langmuir wave in inhomogeneous plasmas is studied analytically in the model of nonlinear Schroedinger equation. Exact solutions in the form of multisolitons are obtained. The theory is applied to the linearly-transformed Langmuir waves at resonance with a driving field.

7069 Photon soliton due to induced Compton scattering. Montes, C. (Laboratoire de Physique de la Matiere Condensee, Nice Cedex, France). pp 222-240 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The induced (nonlinear) Compton interaction between a narrow incoherent photon spectrum—excited to high intensity in a population inversion medium (maser or laser)—and the surrounding plasma, gives rise to a strongly modulated kinetics: the narrow amplified line of width delta ν exhibits large amplitude relaxation oscillations, generating at each oscillation a photon soliton at the Compton-Doppler distance $\Delta\nu$/sub O/ >> delta ν on the red side of the line, which shifts rapidly towards lower frequencies at constant speed sigma and constant amplitude, its logarithmic spectral intensity log N(ν,t) keeping the form: log[N(ν,t)/N/sub O/] = [log(N/sub m//N/sub O/)]exp(-[(ν/sub s/-sigma t)-ν]²/2(anti $\Delta\nu$/sub O/)²) where N/sub O/ is the noise and N/sub m/ the maximum amplitude generated by the source at ν/sub s/ = ν/sub O/ - anti $\Delta\nu$/sub D/, ν/sub O/ being the pumping line frequency. Moreover this photon soliton is the basic element composing any high intensity electromagnetic spectrum in interaction with the plasma electrons via the nonlinear Compton scattering. A narrow spectrum (delta ν less than or equal to anti $\Delta\nu$/sub D/) transforms into one photon soliton and a broad spectrum (delta ν > anti $\Delta\nu$/sub D/) breaks into a set of such solitons.

7070 Nonlinear Langmuir waves in the self-consistent density perturbation. Kato, K.; Mima, K.; Watanabe, M.; Nishikawa, K. (Hiroshima Univ.). pp 363-376 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

A coherent localized Langmuir wave based on the fluid model for both the electrons and the ions is considered. The case when there exist many Langmuir-wave eigenmodes localized in a coherent density cavity is analyzed using the fluid model for both species of particles. The effect of trapped ions on the nonlinear propagation of coherent Langmuir waves is studied. (MOW)

7071 Fluctuations and nonlinear wave processes in a plasma. Sitenko, A.G. (Inst. for Theoretical Physics, Kiev). pp 395-415 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Electromagnetic fluctuations in a nonequilibrium plasma are investigated taking into account nonlinear wave interactions. The spectral distribution of stationary field fluctuations is determined and the possibility of induced fluctuation enhancement by external fields is shown. The scattering and transformation of waves and radiation in nonequilibrium plasmas are studied on the basis of a generalized kinetic equation allowing for interaction between waves and fluctuation fields in plasmas.

7072 Kinetic foundation of the theory of parametric instabilities in a plasma. Balescu, R. (Univ. Libre, Brussels); Paiva-Veretennicoff, I. pp 416-431 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The fourteen plasma dynamical modes on a microscopic level are described. A derivation is given of the mode-coupling equations. The couplings of longitudinal plasma waves and shear modes is shown to give rise to a new type of instability: the "zero-mode"

instability. The coupling of longitudinal plasma waves to ion acoustic waves is then considered. (MOW)

7073 Some remarks on coherent nonlinear coupling of waves in plasmas. Wilhelmsson, H. (Chalmers Univ. of Tech., Goteborg). pp 432-446 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The purpose of the present contribution is to discuss various possibilities of analysing the basic set of coupled equations and to point out inherent difficulties associated with the description of the nonlinear interaction between different types of waves, and for general coupling situations, including deviations from perfect matching of frequencies and wave-numbers. We apply our considerations to specific examples in the field of stimulated excitation of waves, namely to parametric excitation of hybrid resonances in hot magnetized multi-ion component plasma and to laser-plasma interaction.

7074 Effect of finite beat-wave relaxation time and growth-rate modulation on the nonlinear mode coupling between stable and unstable plasma waves. Anderson, D.; Bondeson, A. (Chalmers Univ. of Tech., Goteborg). pp 447-455 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Starting from a situation where an unstable plasma wave is saturated by means of nonlinear Landau damping, an investigation is made of the complicating effects of (i) finite beat wave relaxation time and (ii) an external modulation of the growth rate of the unstable wave. It is shown for case (i) that the finite damping time of the beat mode causes damping or growth of the relaxation oscillations associated with the saturation behaviour, depending on whether the damping rate is larger or smaller than the beat frequency deviation from exact resonance. For case (ii) the parametric instability resulting from a proper choice of modulation frequency is studied in detail and the corresponding growth-rate, threshold, and final saturation level are determined.

7075 Averaged description of the plasma Langmuir waves. Kuznetsov, E.A. (AN SSSR, Novosibirsk. Inst. Avtomatiki i Ehlektrometrii). *Fiz. Plazmy;* **2**: No. 2, 327-333(1976). (In Russian).

The equations describing the Langmuir turbulence with taking account of electron nonlinearities have been obtained. Their effect on collapse of the Langmuir waves has been investigated. It has been shown that the electron nonlinearities can stabilize the collapse development.

7076 Structure of the transverse shock wave front in a magnetized plasma. Velikovich, A.L.; Liberman, M.A. (AN SSSR, Moscow. Inst. Fizicheskikh Problem). *Fiz. Plazmy;* **2**: No. 2, 334-346(1976). (In Russian).

A shock wave propagating in a completely ionized plasma across a magnetic field has been considered. The magnetic field is assumed to be strong, so that the ion Larmor radius is less than the range length. The problem on the shock wave structure is solved on the assumption that plasma has a collisional character in the framework of the two-fluid hydrodynamics. The equations for the Hugoniot adiabat and the range of variations of the Mach numbers in which one or another dissipative processes predominate have been derived in an explicit form. An analytical solution has been obtained for the structure of the shock wave front in the range of the Mach number variations where the ion viscosity and electron-ion collisions leading to energy exchange are predominant.

FUSION POWER PLANT TECHNOLOGY

REFER ALSO TO CITATION(S) 5758

7077 (ANL/FPP—78-1) **Fusion Power Program. Quarterly progress report, January—March 1978.** (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 108p. Dep. NTIS, PC A06/MF A01.

Separate abstracts were prepared for each of the five included sections. (MOW)

7078 (ANL/FPP—78-1, pp 53-87) **Fusion systems engineering.** 1978.

In Fusion Power Program. Quarterly progress report, January—March 1978.

Research during this report period has covered the following areas: (1) fusion reactor systems studies, (2) development of blanket processing technology for fusion reactors, (3) safety studies of fusion concepts, (4) MACKLIB-IV, a new library of nuclear response functions, (5) energy storage and power supply requirements for commercial fusion reactors, (6) blanket/shield design evaluation for commercial fusion reactors, and (7) cross section measurements, evaluations, and techniques. (MOW)

7079 (ANL/FPP/TM—112) **Argonne National Laboratory papers presented at third ANS topical meeting on the technology of controlled nuclear fusion.** (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 82p. (CONF-780508—66; CONF-780508—67; CONF-780508—68). Dep. NTIS, PC A05/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

The 9 papers included in this Technical Memorandum were presented at the Third ANS Topical Meeting on the Technology of Controlled Nuclear Fusion that was held in Santa Fe, New Mexico on May 9-11, 1978.

7080 (CONF-771203—, pp 291-293) **System studies for a tokamak fusion power plant.** Reid, R.L.; Steiner, D. (Oak Ridge National Lab., TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7081 (CONF-771203—, pp 299-301) **ELMO Bumpy Torus: an alternate fusion reactor concept.** Uckan, N.A. (Oak Ridge National Lab., TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7082 (CONF-771203—, pp 25-27) **Fusion power demonstration study at ORNL.** Mense, A.T.; Bettis, E.S.; Huxford, T.J. (Oak Ridge National Lab., TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7083 (CONF-771203—, pp 29-30) **Report on a simple fusion reactor model that is already in operation.** Wells, D.; Davidson, J.; Ziajka, P.; Phadke, L.; Tunstall, J. (Univ. of Miami, Coral Gables, FL). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7084 (DOE/ET—0047) **Evaluation of alternate magnetic fusion concepts, 1977.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1978. 348p. Dep. NTIS, PC A15/MF A01.

The objective of this exercise was to evaluate all of the alternate concepts supported by DMFE with regard to: (1) confidence in the physics assumptions; (2) confidence in the development of the requisite technologies; and (3) the desirability of its pure fusion reactor configuration. A primary concern in developing the evaluation technique described in this section was the need to obtain a uniform, critical evaluation. Motivated by this concern, it was decided to have all of the concepts evaluated on the same basis or criteria and to have all concepts evaluated by the same group of experts. The evaluation criteria and procedures which were developed for this purpose are described. The concepts evaluated were the EBT, RFP, TORMAC, field reversing ion rings, linear theta pinch, laser heated solenoid, e-beam heated solenoid, multiple mirrors, fast linear reactor, LINUS, and SURMAC. (MOW)

7085 (GA-A—15047) **Doublet research at General Atomic Company.** Freeman, R.L.; Adcock, S.J.; Baker, D.R. (General Atomic Co., San Diego, CA (USA)). Jun 1978. Contract EY-76-C-03-0167-038. 12p. Dep. NTIS, PC A02/MF A01.

Vertically elongated tokamaks are widely recognized to have significant advantages for tokamak fusion reactors. Control of the current density profile is essential for optimizing the detailed plasma cross-sectional shapes for MHD stability in order to attain the full potential of elongated configurations. Optimization studies of the doublet configuration utilize a simple model to understand the influence of current density profiles on plasma shape control. A two-dimensional transport code has also been used to demonstrate the use of neutral beam heating to control the plasma shape in Doublet III. Experimental studies on Doublet IIA to investigate the use of lower hybrid waves for auxiliary heating and current profile control are described. We conclude with a Doublet III status report.

7086 (PPPL—1475) **Tokamak fusion test reactor. Final design report.** (Princeton Univ., NJ (USA). Plasma Physics Lab.; Ebasco Services, Inc., New York (USA); Grumman Aerospace Corp., Bethpage, NY (USA)). Aug 1978. Contract EY-76-C-02-3073. vp. (PH-R—007). Dep. NTIS, MF A01.

Portions of document are illegible.

Detailed data are given for each of the following areas: (1) system requirements, (2) the tokamak system, (3) electrical power systems, (4) experimental area systems, (5) experimental complex, (6) neutral beam injection system, (7) diagnostic system, and (8) central instrumentation control and data acquisition system. (MOW)

7087 (SAI—78-568-LJ) **Pre-ignition plasma studies of small high-field ohmically heated tokamaks.** Wagner, C. (Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies). Mar 1978. Contract EY-76-C-03-1018. 37p. (LAPS—38). Dep. NTIS, PC A03/MF A01.

Studies have been made of the feasibility of attaining thermonuclear ignition in a small high-density high-magnetic field tokamak reactor. We have used both the 1-D reactor code MAK1 and a simple point model to determine the viable regions in parameter space, scaling, and parametric sensitivities of such a reactor.

7088 (UCRL—81538) **Tandem mirror reactors.** Carlson, G.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Sep 1978. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

Preliminary fusion reactor designs have been developed based on the tandem mirror confinement concept. These have included a 1000 MWe fusion power reactor and a nearer term fusion-fission hybrid reactor with reduced plasma confinement and technology requirements. Brief descriptions are given.

7089 (UCRL—81600) **Cumulative fuel commitment for light water reactors: is there a uranium crunch. The fusion-fission fuel factory can help.** Werner, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1978. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

It can cautiously be stated that there is not an imminent U.S. uranium crunch, because the installed capacity of fission reactors to 1990 is less than was anticipated. We have time for careful judgment and deliberation. We probably have until at least the year 2000 before beginning the phasing-in of a new technology to augment or replace the light water reactor. Consequently the fusion-fission hybrid appears to have strong potential as a fuel factory supplying fuel to the LWR industry. The hybrid relaxes some of the physics and engineering constraints on pure fusion and should be available somewhat sooner. The hybrid also integrates into the energy plan by supporting fission rather than replacing it. The hybrid seems like a good interface between the eventual pure fusion reactor and fission. The easing of the fission fuel demand under that which was anticipated, coupled with the high probability that available uranium resources are proportional to the price paid per pound (within limits) are likely, more than currently stated, serving to fusion's advantage by buying time for development.

7090 (UCRL—81652) **Philosophy of fusion research.** Post, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Sep 1978. Contract W-7405-ENG-48. 16p. (CONF-780946—6). Dep. NTIS, PC A02/MF A01.

From Driven magnetic fusion reactors; Erice, Italy (18 Sep 1978).

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 5844, 6273, 7118

7091 (ANL/FPP—78-1, pp 46-52) **Experimental power reactor.** 1978.

In Fusion Power Program. Quarterly progress report, January—March 1978.

Research on the following three areas is described: (1) first wall/limiter design, (2) impurity control and, (3) model equilibrium field coil system. (MOW)

7092 (CONF-760558—, pp 148-162) **Low atomic number tokamak first walls.** Rovner, L.H. (General Atomic Co., San Diego, CA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

The first wall of a fusion reactor will be subjected to an extremely hostile environment, and the proper choice of materials and design may be critical to successful operation. A review is presented here of some of the material responses and consequences of interactions with this environment.

7093 (NUREG/CP—0004(Vol.3), pp 1049-1057) **Spectrum unfolding: its application in a CTR model blanket experiment.** Kuijpers, L.; Cloth, P.; Filges, D.; Herzing, R. (Kernforschungsanlage, Juelich, Ger.). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

This contribution deals with neutron dosimetry in the high energy range, which has to be applied in controlled thermonuclear reactor experiments. However, some remarks are given first on the fusion process and attention is paid to the experimental set-up.

7094 (NUREG/CP—0004(Vol.3), pp 1059-1068) **High energy neutron dosimetry for the fusion program.** Barr, D.W.; Norris, A.E. (Los Alamos Scientific Lab., NM). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

Neutron dosimetry by the foil activation method offers a flexible technique for characterizing neutron spectra ranging from thermal energies to 30 MeV with the potential for extension to higher neutron energies as investigated by the Los Alamos Radiochemistry Group at the Los Alamos Meson Physics Facility and in the Apollo-Soyuz Test Project. The use of this method for the neutron flux description in thermal, resonance, and fission spectrum assemblies has been demonstrated. An extension of the method to environments involving thermonuclear processes was developed at Los Alamos in the early 1950's to characterize mixed fission-thermonuclear systems.

7095 (UCRL—52531) **Lithium fall reactor concept: the question of jet stability, with recommendations for further experiments.** Kang, S.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Aug 1978. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

The stability of a liquid-lithium jet flow is of importance in a laser fusion reactor design. In this report we analyze and discuss jet stability with respect to fluid dynamics, delineating physical factors that may affect the jet breakup and performing some simple calculations to determine quantitatively the relative influences of various parameters. We define areas of uncertainty and recommend possible experimental verification, theoretical analysis, or both.

7096 **Reversed-field pinch-burn dynamics.** Stimpson, H.R.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). *Nucl. Fusion;* **18**: No. 7, 974-977(1978).

The behaviour of a plasma contained in a reversed-field pinch device has been described in a global computer code which uses a helical-current model. The potential stability of the plasma during the burn is monitored. Results show that proper selection of key initial parameters, particularly plasma radius and imposed magnetic field, is essential if the burn is to be initiated with the most favourable conditions for prolonged stability and the associated enhanced energy multiplication.

7097 **Cold-gas blanket problem for turbulent plasmas.** Engelmann, F.; Nocentini, A. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). pp 298-304 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

The cold-gas blanket, at least as far as its function as refuelling device is concerned, is a consistent concept only if there exist appropriate steady states of the plasma on a time scale larger than the particle confinement time. The implications of this condition are discussed in general, and the collisional transport model for toroidal geometry is considered as an illustrative example. The importance of a more detailed knowledge about the actual anomalous transport properties for treating the cold-gas blanket problem realistically is displayed.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 7117, 7118, 7119

7098 (CONF-760558—, pp 260-266) **Electrical insulation for large multiaxis superconducting magnets.** Harvey, A.R.; Rinde, J.A. (Lawrence Livermore Lab., Livermore, CA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

The nature and location of insulation for multiaxis superconducting magnets is described. The primary components of the network consist of barrier, interlayer, and interturn insulation. The interturn insulation may be further subdivided into that portion

between turns of either the pancake or helical windings. Ideally, the interturn insulation for both windings would be the same; in practice, this is difficult to achieve. All insulation must provide passage for the liquid helium coolant.

7099 (PPPL—1451) **New techniques for inducing plasma current in large tokamak devices.** Bolton, R.A.; Bromberg, L.; Brown, D.I.; Christensen, U.R.; Jassby, D.L.; Okabayashi, M.; Singer, C.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1978. Contract EY-76-C-02-3073. 12p. (CONF-780508—60). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

Up to 70% of the plasma current in large tokamak devices can be induced by the flux swing of the equilibrium field (EF), if the plasma pressure is increased very early during start-up and maintained at the MHD-limiting value throughout the current rise. In an illustration of this technique, a 4.4-MA plasma current is induced by the EF coils assisted by a set of "leaky OH" coils and a small central solenoid. In a second example, current induction by the EF is supplemented by a 2.0-MA neutral-beam-driven current, and the central transformer is eliminated entirely. A hybrid coil is described, wherein the TF and OH coils are merged into a single winding with greatly reduced net forces. These techniques can alleviate space restriction near the major axis in small-R tokamak reactors.

POWER SUPPLIES, ENERGY STORAGE

REFER ALSO TO CITATION(S) 7117

7100 (ANL/FPP—78-1, pp 88-90) **Magnetic systems.** 1978.

In Fusion Power Program. Quarterly progress report, January—March 1978.

This section briefly considers the energy storage and transfer program and the negative ion source development program. In particular, discussions are given for the homopolar generator, inductor-converter bridge, and a direct extraction H^- source. (MOW)

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 7117, 7118

7101 (CONF-771203—, pp 37-38) **Advanced fuel fusion.** Southworth, F.H. (Florida Power and Light Co., Miami). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7102 (UCRL—52517) **Review of the neutral-beam current requirements for the Mirror Fusion Test Facility (MFTF).** Porter, G.D.; Coensgen, F.H.; Devoto, R.S.; Molvik, A.W.; Osher, J.F.; Shearer, J.W.; Thomassen, K.I. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Aug 1978. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

The techniques used to evaluate the beam-current requirements for MFTF are similar to those in previous studies but incorporate some improvements. In particular, we have enlarged the radial code BUILDUP to allow for a smaller radial grid and to improve the numerical accuracy; we have also improved the model of the atomic physics processes and the particle-equilibrium calculations. Also, a model of plasma containment that conserves energy as well as particles but does not include any effect of the expected drift-cyclotron loss-cone (DCLC) turbulence has been incorporated into the previous studies. We show that the DCLC turbulence increases the average ion energy and decreases the particle confinement time. Because these effects cancel to first order, the beam-current requirements are independent of the turbulence. We find that 24 of the present LBL source modules would sustain a plasma with an average beta of 0.46. This figure is within 10% of the MFTF goal and is within our calculational accuracies. We further show that the beam-current requirements for the large-diameter plasma are consistent with those of experiments to study the buildup of a field-reversed plasma.

7103 (UCRL—81242) **Neutral beam production using negative ions.** Hooper, E.B. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jun 1978. Contract W-7405-ENG-48. 16p. (CONF-780702—7). Dep. NTIS, PC A02/MF A01.

From Symposium on heating in toroidal plasmas; Grenoble, France (3 Jul 1978).

Techniques for producing intense negative ion beams are discussed. These beams are required for intense neutral beam development at energies greater than 150 keV. Handling, acceleration, and stripping of negative ion beams are described.

7104 **Electron losses of fast H^- ions and H^0 atoms when colliding in a plasma target.** Dimov, G.I.; Ivanov, A.A.; Roslyakov, G.V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). *Zh. Tekh. Fiz.;* **47**: No. 9, 1881-1888(Sep 1977). (In Russian).

Processes of electron loss by negative ions and hydrogen and deuterium atoms with 0.4-0.9 MeV energy have been experimentally studied when passing in lithium and magnesium plasma targets. Measurement results of relative cross sections of these processes are presented. The value of maximum extraction of neutral atoms from H^-, D^- negative ions is determined while stripping in plasma targets, which is equal to 80-82% in the ion energy range studied.

7105 **Focusing of high-energy plasma streams in an axial-symmetric magnetic field of a short coil.** Kalmykov, A.A.; Tereshin, V.I.; Chebotarev, V.V.; Yakubovskij, V.G.; Tkachenko, V.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Fiz. Plazmy;* **3**: No. 4, 758-769(1977). (In Russian).

Plasma motion is studied before input into a magnetic trap. In this context consideration has been given to the focusing properties of an axisymmetric magnetic field of a short coil together with the complex system for high-energy plasma flux shaping and purification. The studies have been conducted both experimentally and by calculations method within the model of specular reflection. The following conclusions are made: (1) the focusing properties of the above magnetic field for high-energy plasma fluxes are dependent upon plasma flux parameters and the magnetic field intensity; (2) the focusing region is realized in a space free from external magnetic fields; (3) at a fixed intensity of an external magnetic field the focal region shifts towards the magnetic coil axis with an increase in both the density and velocity of the plasma flux; (4) a drop of the external magnetic field intensity results in a greater focal distance; (5) at a greater focal distance the focal region extends longitudinally; (6) the experimental results are in good qualitative agreement with calculation data.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

REFER ALSO TO CITATION(S) 7078, 7136

7106 (CONF-760558—, pp 163-178) **Tritium transport in nonmetallic solids.** Elleman, T.; Alexander, C.; Causey, R.; Chandra, D.; Fowler, J.; Payne, A.; Ravanbakht, C.; Zumwalt, L.; Verghese, K. (North Carolina State Univ., Raleigh). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

Nonmetallic solids may be used in fusion reactors as tritium diffusion barriers, insulators, structural components, or protective coatings to lower plasma poisoning from first-wall sputtering. The literature on hydrogen permeation, diffusion, and solubility in metals is quite extensive, but little information exists on hydrogen transport or solubility in nonmetals. The purpose of the present investigation is to determine hydrogen or tritium permeabilities, diffusivities, and solubilities in nonmetallic solids of potential interest to the CTR program. A considerable amount of information has now been obtained on tritium diffusion coefficients in a variety of nonmetallic solids, but the permeability and solubility studies are in an early stage.

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 7117

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 6420, 6466, 6472

7107 (CONF-771203—, pp 31-33) **Prospects of generating power with particle-beam-driven inertial confinement fusion.** Varnado, S.G.; Mitchiner, J.L. (Sandia Labs., Albuquerque, NM). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7108 (CONF-771203—, pp 35-36) **Potential of ion beam-pellet fusion as a power source.** Kammash, T.; Campbell, R.B. (Univ. of Michigan, Ann Arbor). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7109 (NRL-MR—3799) **Linear stability of self-similar flow. III. Compressional waves in imploding spherical shells.** Book, D.L.

(Naval Research Lab., Washington, DC (USA)). May 1978. Contract ES-77-A-01-6021. 14p. Dep. NTIS, PC A02/MF A01.

A new, potentially disruptive, phenomenon in target pellets irradiated by laser or particle beams is described. Initially weak standing sound waves (vibrations) in an imploding spherical shell can become comparable in amplitude with the shell thickness if the effective adiabatic index satisfies $\gamma < 5/3$. Detailed calculations with a soluble self-consistent model show the relative amplification is strongest for long-wavelength modes in thin shells with small γ and is insensitive to the density profile.

7110 (UCRL—81197) **Fiber optics in SHIVA.** Severyn, J.; Parker, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jun 1978. Contract W-7405-ENG-48. 21p. (CONF-780917—1). Dep. NTIS, PC A02/MF A01.

From WESCON meeting; Los Angeles, CA, USA (12 Sep 1978).

SHIVA is a twenty arm laser which is controlled with a network of fifty computers, interconnected with digital fiber optic links. Three different fiber optic systems employed on the Shiva laser will be described. Two of the systems are for digital communications, one at 9600 baud and the other at 1 megabaud. The third system uses fiber optics to distribute diagnostic triggers with subnanosecond jitter.

7111 **Interpretation of experiments in laser-driven fusion.** Brueckner, K.A. (Univ. of California, San Diego, La Jolla). pp 9-27 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

An analysis is given for the number and energy distribution of superthermal electrons produced in a laser-heated plasma. The result is independent of the spatial and temporal distribution of electron density and temperature. The effects of electrostrictive forces on a laser-heated plasma have been calculated for different laser wavelengths using a hydrodynamic code of standard form. Large density discontinuities and marked fluctuations in reflectivity are predicted. Hydrodynamic calculations of shell implosions show a marked dependence on laser wavelength for wavelengths less than one micron. The coupling to the dense imploded shell rises from 6% at one micron to 33% at 0.1 microns, increasing possible energy multiplication in a pellet from approximately 60 to 400.

7112 **Experiments on the absorption of high intensity laser light and subsequent compression of spherical targets.** Johnson, R.R. (KMS Fusion, Inc., Ann Arbor, MI). pp 28-46 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Experiments show that it is possible to achieve high compression from spherical targets using high-energy pulsed laser systems. Compression of the fuel in the target has been measured to be approximately 20 times solid and neutron generation greater than 10^7 was observed. A marked increase in absorption and neutron yield was observed on going from the single pass to the circulating double pass laser configuration. The data on absorption by low- and high-Z targets obtained in this set of laser-target experiments does not permit an unambiguous determination as to whether the classical inverse bremsstrahlung mechanism is dominant and whether radiative preheat is reduced. In addition to a determination of the Z-dependence of the absorption, a concomitant measurement of the plasma density scale length is required in order to specify this currently unknown parameter. Greater insight into the nature of the absorption process can also be obtained by studying the variation of absorption with incident laser wavelength. The inverse bremsstrahlung model predicts that absorption varies approximately as lambda^{-2} where lambda is the wavelength. Hence, for fixed ZL/phi$_0$, going from 1.06 μm to 0.53 μm illumination should give a significant increase in absorption.

7113 **Compression of laser-irradiated hollow microspheres.** Basov, N.G.; Zakharenkov, Yu.A.; Zorev, N.N.; Koligrivov, A.A.; Krokhin, O.N.; Rupasov, A.A.; Sklizkov, G.V.; Shikanov, A.S. (Lebedev Inst. of Physics, Moscow). pp 47-63 of Plasma physics: nonlinear theory and experiments. Wilhelmsson, H. (ed.). New York; Plenum Press (1977).

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Experimental results are discussed on the interaction of nanosecond laser radiation with hollow microspheres. The plasma-absorbed energy, spectral distribution, and the energy of plasma-scattered radiation were determined by various methods. The influence of initial perturbations on the microsphere compression stability was studied. By using pinhole cameras one succeeded in registering a 200-fold bulk compression of shells with uniform walls.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 6234, 6247, 6257, 6258, 6274, 6848, 7098

7114 (ANL/FPP—78-1, pp 1-45) **Fusion reactor materials.** 1978.

In Fusion Power Program. Quarterly progress report, January—March 1978.

Summaries of research are given for the following areas: (1) surface damage of SS-316 by high dose $^4He^+$, (2) blisters in $^4He^+$-irradiated nickel, and vanadium, (3) sputtering yields for D on gold, (4) fast-neutron sputtering of gold, (5) some dosimetry and damage analysis studies, (6) hydrogen permeation studies, and (7) ion-implantation damage in amorphous and crystalline $Nb_{40}Ni_{60}$.

7115 (CONF-760558—) **CTR electrical insulators.** (Department of Energy, Washington, DC (USA). Div. of Magnetic Fusion Energy). Feb 1978. 311p. Dep. NTIS, PC A14/MF A01.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

Separate abstracts have been entered into the data base for each included paper. (MOW)

7116 (CONF-760558—, pp 3) **Working group summary.** Scott, J.L.; Clinard, F.W.; Diethorn, W.S.; Goland, A.N. Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CRT electrical insulators.

Highlights of the conference are summarized. Some of the needs for future research are outlined. (MOW)

7117 (CONF-760558—, pp 6-37) **Electrical insulator requirements for mirror fusion reactors.** Condit, R.H.; Van Konynenburg, R.A. (Lawrence Livermore Lab., Livermore, CA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CRT electrical insulators.

The concept for a mirror fusion reactor is being developed in stages which progress from present physics experiments to a power reactor design, and these envision various operating conditions. These devices will require electrical insulators in four main locations: (1) The neutral-beam injector which supplies fuel to the plasma. (2) The injector power supplies. (3) The direct converters which convert ion leakage from the plasma into useful current. (4) The superconducting magnets used in plasma confinement. Requirements are given for each location.

7118 (CONF-760558—, pp 54-64) **Insulator requirements for tokamaks.** Scott, J.L. (Oak Ridge National Lab., TN). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CRT electrical insulators.

Various EPR studies have identified four areas where insulation is a potential problem in a tokamak. These are insulation between blanket modules; insulation in the ion source and bending magnet of the neutral-beam injectors; insulation in the vertical field coils, which "position" the plasma; and insulation in the superconducting toroidal field coils. The feature that leads to problems is the radiation damage to which these insulators are exposed in addition to their normal operating environment. These problems are discussed in this paper.

7119 (CONF-760558—, pp 65-81) **Superconducting magnetic electrical insulations.** Hay, R.D. (Magnetic Engineering Associates, Inc., Cambridge, MA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CRT electrical insulators.

Illustrations are presented to emphasize specific insulation design features. Magnets for mirrors and tokamaks are discussed. Operational requirements for the various insulators are described along with some candidate materials. (MOW)

7120 (CONF-760558—, pp 88-89) **Mechanical properties of insulator materials.** Evans, A.G. (Rockwell International, Thousand Oaks, CA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

Some design basics for structural ceramic components that can be expected to survive in the presence of substantial in-service tensile stress are briefly discussed. (MOW)

7121 (CONF-760558—, pp 109-120) **Electrical properties of irradiated insulators for fusion reactors.** Van Lint, V.A.J. (Mission Research Corp., San Diego, CA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

Exposure dependent phenomena that affect conductance through the electronic and ionic conductivity are listed. Some of these mechanisms are discussed, applying the knowledge that exists in an attempt to scale across the gaps that separate existing data from the RTPR insulator conditions which are being considered for illustrative purposes.

7122 (CONF-760558—, pp 123-129) **Proton and deuteron bombardments of insulators.** Gruen, D.M. (Argonne National Lab., IL). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

Insulators are important structural materials in some thermonuclear devices such as theta pinches. Certain tokamak designs also involve insulators as electrical feedthroughs which are in close proximity to plasma regions. In contradistinction to noble gas ions, D^+ and T^+ are reactive particles whose interactions with insulator surfaces, such as metal oxides or nitrides, result in chemical reactions leading to a variety of sputtered products as well as surface compounds. The effects of such interactions can have serious consequences for the performance of insulators. For example, reduction of surface and subsurface layers to lower oxides and possibly to metal can degrade insulating properties below acceptable levels. Although sputtering and ion implantation of metals are reasonably well understood phenomena, much less work has been done on insulating materials. In particular, the effects of the chemically active energetic hydrogen isotope ions on insulators have only begun to be appreciated, and we need to assess these effects in terms of insulator performance for MFE applications.

7123 (CONF-760558—, pp 130-147) **Hydrogen and helium implantation in insulating glasses.** Mattern, P.L. (Sandia Labs., Livermore, CA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

This is an outline of a talk given at the CTR Electrical Insulator Meeting, sponsored by MFE/ERDA, at Los Alamos Scientific Laboratory, May 17—19, 1976. The intent is to present a status report of Sandia Laboratories, Livermore, insulator research related to CTR applications.

7124 (CONF-760558—, pp 179-198) **Review of properties of Atomics International glass insulator coatings.** Keefer, D.W.; Roberts, J.T. (Atomics International, Canoga Park, CA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

The purpose of this paper is to review the experimental results of programs that were initiated because of the proposed use of AI coatings in a theta pinch reactor. As time has passed, however, it has become evident that the coatings may have uses in fusion reactors other than theta pinch and in applications other than as a first-wall liner material. Possible uses of the coatings in flux breakers, in neutral-beam injectors, and as tritium barriers are being considered, and these possibilities should be borne in mind during examination of the experimental results.

7125 (CONF-760558—, pp 199-212) **Insulator irradiation studies at Brookhaven National Laboratory.** Goland, A. (Brookhaven National Lab., Upton, NY). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

The experimental program at the BNL Physics Department has concentrated on the measurement of the radiation-induced conductivity of Al_2O_3. In any of the potential fusion reactors there will be a background dose rate of ionizing radiation resulting from the neutron activation of materials making up the reactors. For example, a level of 10^4 rads/sec has been estimated for the CTR theta-pinch reactor. Therefore, it is important to determine the effect of a continuous ionizing radiation level on the electrical properties of reactor insulating materials. Accordingly, we have measured the steady-state a-c electrical conductivity of single crystal Al_2O_3 during continuous electron irradiation at 1.5 MeV at dose rates up to 5×10^5 rads/sec.

7126 (CONF-760558—, pp 240-259) **CTR electrical insulator studies at Battelle Pacific Northwest Laboratories.** Bates, J.L.; Garnier, J.E. (Battelle Pacific Northwest Labs., Richland, WA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

The studies at PNL (excluding sputtering development) have centered around the assessment of CTR electrical insulator requirements for CTR application; the development of methods for accurate determination of the electrical properties, i.e., electrical resistivity and dielectric breakdown; the evaluation of some reference oxide insulators, such as Al_2O_3 and BeO and the preliminary evaluation of some potential insulators, i.e., $Al_2O_3 \cdot MgO$, $3Y_2O_3 \cdot 5Al_2O_3$, and Y_2O_3. (MOW)

7127 (CONF-760558—, pp 269-275) **Working group summary.** Dickinson, J.M.; Hay, R.D. Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

A very briefly outlined status of CTR insulator design and fabrication information is given. Areas that show promise for CTR activities where perhaps even a breakthrough or two can be conjured up through new and innovative approaches to ceramic technology are discussed. Fruitful avenues for future research and development activities with a big emphasis on development are suggested.

7128 (CONF-760558—, pp 276-287) **CTR electrical insulators: the reactor designer's viewpoint.** Krakowski, R.A. (Los Alamos Scientific Lab., NM). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

From the viewpoint of reactor structural design, the requirements imposed by fast-neutron radiation damage upon fusion power systems will be more severe than for fission power reactors. A simple calculation shows that the fast-neutron flux per unit of blanket power density is about 10-100 times greater for D-T fusion than for fission systems. In addition to fast-neutron damage, energetic charged and neutral particles emanating from the plasma will also be incident on those materials exposed to the plasma. The particle fluxes at the first wall anticipated for three major fusion power concepts are given. In some instances the materials exposed to this environment may be electrical insulators. Major insulator questions and/or data requirements according to fusion reactor concept are discussed. Because of the inherent need of fast pinches to drive magnetic flux at relatively fast rates (voltage = time rate of flux), pulsed dielectric material will be required at or near the first wall. The more crucial nature of the insulator requirement for fast pinches are described.

7129 (CONF-760558—, pp 288-304) **Engineering considerations of insulator usage in fusion devices: the ceramic fabricator's viewpoint.** Elsner, N.B.; Chin, J. (General Atomic Co., San Diego, CA). Feb 1978.

From CTR insulator meeting; Los Alamos, NM, USA (17 May 1976).

In CTR electrical insulators.

This review is presented to describe the technologies that might be used for fusion reactor materials development and concentrates in discussing coating technology, processes for fabricating ceramic materials, and methods for fabricating insulating joints. The fabrication techniques discussed are for high-temperature insulator operation. No effort has been made to consider the organic materials which are used from cryogenic temperatures to approximately 250°C. Some of the fabrication techniques presented are generic in nature, and some of these techniques that previously have only been applied to fabricate metals may also be utilized to fabricate insulating materials and insulating joints.

7130 (CONF-771203—, pp 279-281) **Materials technology for structural components of fusion reactors.** Horak, J.A. (Oak Ridge National Lab., TN). 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7131 (CONF-771203—, pp 283-285) **Plasma-wall interaction and the tokamak fusion reactor.** Styris, D.L. (Battelle Pacific Northwest Labs., Richland, WA); Thomas, M.T.; Baer, D.R.; Woo, J. 1977.

From Alternative energy sources symposium; Miami Beach, FL, USA (5 Dec 1977).

In Miami international conference on alternative energy sources.

7132 (DOE/ET—0065/1) **Damage analysis and fundamental studies. Quarterly progress report, January—March 1978.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). Aug 1978. 260p. Dep. NTIS, PC A12/MF A01.

This report is the first in a series of Quarterly Technical Progress Reports on "Damage Analysis and Fundamental Studies" (DAFS), which is one element of the Fusion Reactor Materials

Program, conducted in support of the Magnetic Fusion Energy Program of the U.S. Department of Energy. The DAFS program element is a national effort composed of contributions from a number of National Laboratories and other government laboratories, universities, and industrial laboratories. It was organized by the Materials and Radiation Effects Branch, Office of Fusion Energy, DOE, and a Task Group on Damage Analysis and Fundamental Studies which operates under the auspices of that Branch. The purpose of this series of reports is to provide a working technical record of that effort for the use of the program participants, for the fusion energy program in general, and for the Department of Energy. This report is organized along topical lines in parallel to a Program Plan of the same title (to be published) so that activities and accomplishments may be followed readily relative to that Program Plan. Thus, the work of a given laboratory may appear throughout the report. Chapters 1 and 2 report topics which are generic to all of the DAFS Program: DAFS Task Group Activities and Irradiation Test Facilities, respectively. Chapters 3, 4, and 5 report the work that is specific to each of the subtasks around which the program is structured: A. Environmental Characterization, B. Damage Production, and C. Damage Microstructure Evolution and Mechanical Behavior.

7133 (HEDL-TME—78-65) **FMIT Test assemblies. Progress report.** Nygren, R.E.; Opperman, E.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1978. Contract EY-76-C-14-2170. 81p. Dep. NTIS, PC A05/MF A01.

This progress report is a reference document for a number of inter-related tasks supporting the Fusion Materials Irradiation Test (FMIT) Facility being developed by the Hanford Engineering Development Laboratory. The report describes the basic configuration of test assemblies and supporting rationale based on the neutron flux distribution. Perturbed and unperturbed flux profiles are discussed as well as heating rates and cooling requirements.

7134 (M—94) **Experimenter's guide: Rotating Target Neutron Source II Facility.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

The Experimenter's Guide is intended to do the following: (1) assist prospective users of the Rotating Target Neutron Source II (RTNS-II) in determining the suitability of the Facility for radiation experiments, (2) establish the procedures whereby radiation experiments are proposed and executed, (3) delineate the various limitations imposed upon such experiments by both source design and safety, and (4) describe the equipment and services available at the Facility.

7135 (NUREG/CP—0004(Vol.3), pp 1031-1048) **Application of the INS facility as a high-flux benchmark for neutron dosimetry and for radiation damage studies in D—T fusion spectra.** Dierckx, R.; Emigh, C.R. (Los Alamos Scientific Lab., NM). 1977.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

In Dosimetry methods for fuels, cladding, and structural materials.

An Intense Neutron Source facility (INS), is presently under construction at the Los Alamos Scientific Laboratory. This facility is being built by the Energy Research and Development Administration for the radiation damage program in magnetic fusion energy. The facility will contain two D-T neutron sources, both producing about 10^{15} primary 14-MeV neutrons per second on a continuous basis. One source will be used to produce a "pure" 14-MeV spectrum while the other will be surrounded by a multiplying blanket converter to produce a fusion-like spectrum with a total of about 10^{16} neutrons per second.

7136 (ORNL—5383, pp 48-51) **Fusion energy studies.** Aug 1978.

In Chemical Technology Division annual progress report for period ending March 31, 1978.

The following topics are considered: (1) cryosorption vacuum pumping for fusion reactors, (2) TNS support studies, (3) tritium recovery from irradiated Li-Al and SAP, (4) actinide oxides, nitrides, and carbides, and (5) transition metal-actinide-C phase equilibria. (MOW)

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 5999

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 5975, 6502, 7169, 7170

7137 (BNWL-SA—6499) **Computer graphics capabilities at Battelle, Pacific Northwest Laboratories.** Dionne, P.J.; Erickson, M.D.; Hill, E.R.; Burnett, R.A.; Addison, L.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1977. Contract EY-76-C-06-1830. 42p. (CONF-7706144—1). Dep. NTIS, MF A01.

From ERDA graphics conference; Washington, DC, USA (Jun 1977).

Portions of document are illegible.

Some of the computer graphics capabilities at Battelle, Pacific Northwest Laboratories are discussed. Computer graphics philosophy, hardware systems, and software utilized by the Computers and Information Systems Section staff are described in an overview. Subsequent sections detail specific applications of these capabilities to research areas in which Battelle is involved. Use of computer graphics in cartography, decision making, and resource assessment is documented.

7138 (CONF-771042—) **Proceedings of the 1977 DOE statistical symposium.** Gardiner, D.A.; Truett, T. (comps.). (Oak Ridge National Lab., TN (USA)). Mar 1978. Contract W-7405-ENG-26. 191p. Dep. NTIS, PC A09/MF A01.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

Individual abstracts were prepared for twelve of the papers in this volume for inclusion in ERA; five of these will also be cited in EAPA. Two additional papers have already been cited in ERA; these may be found by referring to CONF-771042— in the Report Number Index. An after-dinner address on "Would you want your child to be a statistician." was not processed. (RWR)

7139 (CONF-771042—, pp 3-17) **Harmonic regression.** Anscombe, F.J. (Yale Univ., New Haven). Mar 1978.

From 3. ERDA statistical symposium; Richland, WA, USA (26 Oct 1977).

In Proceedings of the 1977 DOE statistical symposium.

Ordinary linear regression, by the method of least squares, is used to determine a linear relation between given independent observations of two or more variables. An analogous problem for time series is to determine a linear relation between two or more given stationary series. The linear relation may take the form that one series is a linear filtering of the other series, plus a stationary error process. The coefficients of the filter can be determined directly by multiple regression in the time domain, but there are various difficulties. An easier procedure, leading to more intelligible results, is to estimate the Fourier transform of the coefficients of the filter, which can be expressed in terms of a gain function and a phase-shift function, by a simpler regression calculation in the frequency domain. The procedures are illustrated by a study of the interrelationship of an annual series of output of U.S. copper mines from 1860 to 1975 and two annual economic series relating to the same years, namely a series of copper prices at New York and a series of the total dollar value of general imports of merchandise into the United States. 10 figures.

7140 (CONF-780727—1) **Computer mapping software and geographic data base development: Oak Ridge National Laboratory user experience.** Honea, B.; Johnson, P. (Oak Ridge National Lab., TN (USA)). 26 Jul 1978. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

From Conference on computer mapping software and data bases; Cambridge, MA, USA (26 Jul 1978).

As users of computer display tools, our opinion is that the researcher's needs should guide and direct the computer scientist's development of mapping software and data bases. Computer graphic techniques developed for the sake of the computer graphics community tend to be esoteric and rarely suitable for user problems. Two types of users exist for computer graphic tools: the researcher who is generally satisfied with abstract but accurate displays for analysis purposes and the decision maker who requires synoptic and easily comprehended displays relevant to the issues he or she must address. Computer mapping software and data bases should be developed for the user in a generalized and standardized format for ease in transferring and to facilitate the linking or merging with larger analysis systems. Maximum utility of computer mapping tools is accomplished when linked to geographic information and analysis systems. Computer graphic techniques have varying degrees of utility depending upon whether they are used for data validation, analysis procedures or presenting research results.

7141 (DP—1506) **MC6800 cross-assembler for the PDP-8/E digital computer.** Sand, R.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1978. Contract EY-76-C-09-0001. 87p. Dep. NTIS, PC A05/MF A01.

A cross-assembler was developed to assemble Motorola MC6800 microprocessor programs on a digital Equipment Corporation PDP-8/E minicomputer. This cross-assembler runs in 8K of core under the OS/8 operating system. The advantages of using the cross-assembler are the large user symbol table and the convenience and speed of program development. User's instructions for the cross-assembler are given. The design of the cross-assembler and examples of its use are described. 12 figures.

7142 (LA—7417-C) **CUBE (Computer Use By Engineers) symposium abstracts.** Ruminer, J.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 109p. (CONF-781024—(Absts.)). Dep. NTIS, PC A06/MF A01.

From CUBE symposium abstracts; Los Alamos, NM, USA (4 Oct 1978).

This report presents the abstracts for the CUBE (Computer Use by Engineers) Symposium, October 4, through 6, 1978. Contributors are from Lawrence Livermore Laboratory, Los Alamos Scientific Laboratory, and Sandia Laboratories.

7143 (LA—7467-MS) **FORTRAN extended interactive debugging aid.** Kazek, C.S. Jr. (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract W-7405-ENG-36. 14p. Dep. NTIS, PC A02/MF A01.

The need for a postprocessor type of debugging aid has long been recognized. When a user's program runs into trouble, the user should be given as much information as possible about the problem and be able to interact with the computer to get additional debugging information before the computer run terminates. This philosophy led to the development of the FORTRAN Interactive Debugging Aid (FID). Later, FID was expanded to allow a user to control the execution and debugging of his program dynamically. This report describes FID's structure, capabilities, and options. FID is a proven debugging tool, and is widely used by programers at the Los Alamos Scientific Laboratory.

7144 (LBL—7953) **Proceedings of the third Berkeley workshop on distributed data management and computer networks.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 377p. (CONF-780828—). Dep. NTIS, PC A17/MF A01.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

Individual abstracts were prepared for twenty of the papers in these proceedings. The remaining two have already been cited in ERA and can be found by referring to LBL—7953 in the Report Number Index. (RWR)

7145 (LBL—7953, pp 1-20) **Provisional model of open system architecture.** Bachman, C.W. Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

A lightly edited report on standards in distributed systems is given. This report attempts to establish the basic reference model in the form of layered architecture; define the number and names of the specific layers composing the reference model; and describe, for each layer, its purpose, the concepts that it supports, and the services/functions that it provides. The following layers are envisioned (in ascending order): physical control, link control, network control, transport end-to-end control, session control, presentation control, and application control. 5 figures. (RWR)

7146 (LBL—7953, pp 21-35) **Software architecture for a microprocessor-based packet network.** Opderbeck, H.; Hoffmeier, J.H.; Spitzer, R.L. Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Continuing improvements in the cost effectiveness of digital electronics have resulted in progressive step-function improvements in the cost effectiveness of packet-switched data communications networks. First- and second-generation packet switching systems utilized minicomputers for switching and network control functions. Third-generation packet switching networks will be based upon multimicroprocessor systems which offer greater flexibility, reliability, and cost effectiveness than minicomputer-based systems, particularly in an environment in which traffic is growing rapidly and a variety of communication interfaces must be accommodated. This paper describes the motivation for and the architectural design of a family of multimicroprocessor-based systems, developed for and currently installed throughout Telenet Communication's public packet switching network. The hardware architecture of these systems, called Telenet Processors, has been described. This paper describes the software architecture of the Telenet Processors, the relationship between the software structure and the hardware structure, and the special facilities incorporated in the software to accomplish the design objectives. 8 figures.

7147 (LBL—7953, pp 36-53) **Protocol converters and user interface in the CYCLADES network.** Naffah, N.; Zimmermann, H. (IRIA, Rocquencourt, France). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

In 1975, the CYCLADES computer network moved from experimental to operational stage. Since then two factors in particular have influenced new developments and studies in CYCLADES—the drastic reduction of the cost of the microprocessors and LSI memories, and adoption of recommendation X25 in the CCITT as a standard interface for public packet switching networks. The first factor opened up new possibilities for interconnection products hardware. New concentrators for connecting TTYs and Interface Converters for connecting hosts were designed around a multimicroprocessor system (MLV). A new microprogramed multiplexer (MUMI) was also developed in order to extend the network interface near the host site. An Intelligent Terminal (TIPAC) was microprogramed for connecting three data-entry display stations to the network. The second factor brought about the need to study the problem of interconnection of Datagram Networks with Virtual Circuit (X25) Networks. CYCLADES conducted a study to solve such a problem. The aims of this paper are to give the general design of a "Customized User Interface" (CUI) for connecting any type of Informatic equipment (terminal, host, ...) to the network, and to present an overview of the different Protocols converters that were developed and studied in CYCLADES. The principal factors which affected the design of these products are discussed. Emphasis is given to products based on microprocessor technology.

7148 (LBL—7953, pp 54-65) **Architecture for secure packet-switched networks.** Padlipsky, M.A. Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

A broad approach to making packet-switched networks secure by means of judicious application of security kernel technology is offered. The central insight is that the expedient of having a single uncertified process for each Host homed on a given kernelized packet switch can, in conjunction with a single uncertified Network Daemon process on each switch, lead to an architecture which is at once secure and possessed of such other desirable characteristics as requiring less verification than other kernelized approaches, avoiding inordinate process overhead, preserving the integrity of networking protocols, and being readily comprehensible.

7149 (LBL—7953, pp 161-168) **Inter-network fragmentation and the TCP.** Shoch, J.F. (Xerox Palo Alto Research Center, CA). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

In the interconnection of heterogeneous computer networks a significant problem may arise: some networks are prepared to generate packets that may be larger than the maximum packet size of a subsequent network. If these large packets are not simply prohibited, then a method must be found to cut them into smaller fragments. Fragmentation alternatives affect the source and destination processes, and particularly impact the internetwork gateways that may lie between differing networks. Three alternatives are available to a gateway encountering an oversized packet: discard it (not acceptable), perform intranetwork fragmentation, perform internetwork fragmentation. Advantages and disadvantages of these alternatives are given, and the choice of a system-wide strategy is discussed. The initial designs of the Internetwork Transmission Control Program (TCP) attacked the problem by integrating a full internetwork fragmentation scheme into the higher-level protocol. Subsequent discussion led to proposals for major change to the TCP fragmentation strategy. (RWR)

7150 (LBL—7953, pp 169-177) **Dynamic management of packet radio slots.** Ricart, G.; Agrawala, A.K. Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Different protocols may offer better performance under different loading conditions in a packet radio network. The concept of an adaptation algorithm is presented which allows the network to shift from one transmission technique to another dynamically as the load changes in order to keep performance high. The resulting single control algorithm is a hybrid of the individual protocols which has

overall characteristics superior to either of its component parts. It adjusts to load changes by making changes in slot allocations and policies to be used in those slots. The adaptation algorithm which moves the scheme from one policy to another can be executed independently and identically as a distributed algorithm by stations in the network without the overhead of control messages. An example slot management scheme is presented which behaves like a nondeterministic low-delay scheme at low offered load but switches smoothly to a high-utilization Time Division Multiple Access at high loading levels. This combination permits both low delay times at low loading levels and full utilization at high loading. In another example, the dynamic nature of the adaptation algorithm produces an average delay time less than either of the two techniques being blended in the cross-over region. 3 figures.

7151 (LBL—7953, pp 178-185) **Failsafe distributed algorithms for routing in communication networks.** Segall, A. (Technion-Israel Inst. of Tech., Haifa). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Several algorithms for routing of information in communication networks are presented. All protocols are characterized by distributed computation, loop-freedom in the routing tables for each destination in the network, adaptability to changes in flow requirements, and immunity in face of arbitrary number, location, and timing of topological changes. Two algorithms converge to the minimum delay routing in message and line-switched networks, respectively. A third, somewhat simpler, algorithm maintains at any given time only one route between each pair of nodes in the network and converges to the shortest paths between each source and each destination in terms of arbitrary weights on the links. 1 figure.

7152 (LBL—7953, pp 289-321) **Design of elementary distributed systems.** Yeh, R.T.; Chandy, K.M. (Univ. of Texas, Austin). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Distributed systems range from the elementary to the very complex. This paper is concerned with the design of elementary systems in which there are no multiple copies of files, transactions exhibit a high degree of geographic locality, and the network topology is a tree. Issues considered include the selection of processors at different sites in the network, line topology and bandwidths, and allocation of application functions to processors. A case study is presented. 15 figures, 2 tables, 65 references.

7153 (LBL—7953, pp 322-339) **Synchronization in distributed system modules.** Bochmann, G.V. (Univ. of Montreal). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

The communication delays between the different components of a distributed system often create problems for the logical consistency of the overall system behavior. The ideas presented suggest how to eliminate these problems by observing certain regularity constraints during the system design, which guarantee that the logical behavior of the system is independent of the communication delays. A descriptive model for the specification of distributed systems is presented, and system properties which imply regular system behavior are defined. Several criteria for checking the regularity of a given system are discussed. The application of the concepts presented is illustrated by several examples.

7154 (LBL—7953, pp 340-357) **Performance limits of the TMM protocol: modelling and measurement.** Gelenbe, E. (IRIA, Le Chesnay, France); Grange, J.L.; Mussard, P. Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

The TMM protocol uses a stop-and-wait procedure with acknowledgements for error control. The purpose of this paper is to investigate the basic limits of TMM with respect to its utilization of available line capacity. Measurement results are obtained and a mathematical model is presented in order to predict TMM's performance and to derive optimum average lengths for random-length or fixed-length packets. 11 figures.

7155 (LBL—7953, pp 358-371) **Distributed simulation using a network of microcomputers.** Peacock, J.K.; Wong, J.W.; Manning, E. (Univ. of Waterloo, Ont.). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Simulation, particularly of networks of gueues, is an application with a high degree of inherent parallelism and is of great practical interest. This parallelism can hopefully be exploited by performing simulations by use of a network of cheap, but slow, microprocessors. A taxonomy is defined to classify a number of parameters of a distributed simulation method and seek solutions to problems of synchronization, deadlock prevention, and interprocess communication arising with various methods in each class of the taxonomy. Emphasis is on the class (loose, event-driven) which seems to possess the greatest potential parallelism, and on the class (tight, time-driven) which allows mock-up studies of real systems. Algorithms are given for deadlock prevention and detection, and the design of a distributed operating system to support the simulation application is briefly discussed. 3 figures.

7156 (ORNL/CSD/TM—44) **Revised version of SLIDES: a program to draw slides and posters.** McCollough, D.H.; Fischer, K.N. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). Sep 1978. Contract W-7405-ENG-26. 79p. Dep. NTIS, PC A05/MF A01.

SLIDES is a program which takes text and commands as input and prepares lettered slides and posters. Originally written by Richard Bertrand and John Schofield at Argonne National Laboratory, SLIDES has been modified to operate in an interactive design mode on the PDP-10 as well as in a batch production mode on IBM 360/75 and 360/91 computers. When run on the time-sharing computer, the program can display its output on a graphics terminal; in batch, in can direct its output to a variety of plotters. The program uses DISSPLA graphical subroutines. This report, revised from ANL-77-26, contains material written for the beginning user, who should be able to produce useful slides or posters by following the examples. This report also serves as a complete reference for the SLIDES program. 12 figures.

7157 (ORO—3443-70) **Reliability and optimality of the finite element method.** Babuska, I.; Rheinboldt, W.C. (Maryland Univ., College Park (USA)). Apr 1978. Contract EY-76-S-05-3443. 34p. (CONF-781019—1). Dep. NTIS, PC A03/MF A01.

From Symposium on future trends in computerized structural analysis and synthesis; Washington, DC, USA (30 Oct 1978).

An overview is presented of the authors' recent theoretical and experimental results on reliable and computationally efficient a posteriori error bounds for finite element solutions. These estimates are composed from error indicators evaluated on the individual elements, and these indicators in turn allow for a very effective approach to the effective construction of optimal meshes. Finally, some views are presented about possible future trends in the development of finite element software, and an outline is given of the design of an experimental finite element system currently under development which incorporates many of these ideas and results.

7158 (SAND—78-0331) **Hard-copy plotter/printer for the CDC6400 computer user-oriented data reduction system. Part I.** Schultheis, T.M. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 101p. Dep. NTIS, PC A06/MF A01.

An on-line plotting system, which uses the Gould 4800-11, was developed for the CDC6400 computer user-oriented data reduction, playback, and processing system. The functional capabilities of the Gould plotter are discussed, together with the hardware interface, which was developed by Division 9422. The interface discussion includes the command instructions associated with the interface, as well as logic diagrams, timing diagrams, and a verbal description of the logic hardware.

7159 (SAND—78-0846C) **Comments on the establishment and management of a quality software library.** Jones, R.E.; Scott, M.R. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 6p. (CONF-781104—1). Dep. NTIS, PC A02/MF A01.

From Workshop on functional and performance issues; San Diego, CA, USA (15 Nov 1978).

The successful establishment and management of a library requires that there be a clearly defined operating philosophy. The following tasks are discussed in this report: defining the audience of the library, selecting high-quality software, integrating the software into the library, deleting absolete software, supplying the library in a readily accessible form, providing documentation, maintaining the library, publicizing the library, consulting on the use of the library, and monitoring use of the library. (RWR)

7160 (SAND—78-1347) **Variable order Runge—Kutta code RKSW and its performance.** Shampine, L.F.; Wisniewski, J.A. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 11p. Dep. NTIS, E02/MF E02.

The code RKSW was written for the solution of the initial-value problem for non-stiff and mildly stiff ordinary differential equations when evaluation of the equations is not expensive. It is

efficient for a wide range of accuracies. Many algorithms in RKSW are unique, or at least novel for a production-grade Runge—Kutta code. Listings are provided for the code in FLECS and FORTRAN, as are extensive numerical results illustrating its performance. To assist in the evaluation of the code, its performance is compared to that of the two best fixed-order Runge—Kutta codes, RKF45 and DVERK, and to a Gragg—Bulirsch—Stoer extrapolation code, DREBS, which varies its order. (RWR)

7161 (SU—326-P.39-29) **Design description of the Nova 3 Cartridge Disk Emulator on the Stanford Emmy system.** Hafeman, D.R. (Stanford Univ., CA (USA). Digital Systems Lab.). Jun 1978. Contract EY-76-S-03-0326-039. 18p. Dep. NTIS, PC A02/MF A01.

The emulation of a Nova 4047A Cartridge Disk System on the Stanford Emmy is described. The Cartridge Disk Emulator (CDE) serves as a peripheral to a Nova 3 processor emulator, also installed on the Emmy. With a disk system, DG disk-based operating systems can be installed; a wide range of programs can thus be studied. The Cartridge Disk Emulator uses the Mini UNIX system to provide I/O services and manage the physical disk resources. CDE transforms Nova I/O commands into UNIX file access requests and processes all status resulting from those requests. All other peripheral emulators currently installed on Novaem are small, simple programs that may easily be understood from the program listing. CDE, however, is in itself a very complex program. It is comparable in complexity and code space to the entire Nova Code Emulation Program. Therefore, a document dedicated to its description is required. Appendix A of this document discusses how to add a new peripheral to NovaemU and NovaemCD. 1 figure, 1 table.

7162 (SU—326-P.39-30) **Nova 3 emulator on the Stanford Emmy system.** Hafeman, D.R. (Stanford Univ., CA (USA). Digital Systems Lab.). Jun 1978. Contract EY-76-S-03-0326-039. 34p. Dep. NTIS, PC A03/MF A01.

A Nova 3 emulator based on the Emmy host machine of the Stanford Emulation Laboratory is described. This is a "class A" code emulator (emulates user-accessible aspects of the Nova 3) and includes a basic set of emulated peripherals, such as paper tape, TTY, and real-time clock. Of particular interest is the software interface between the emulator and the laboratory peripheral system via the UNIX operating system. Through this interface the emulator user may employ the full power of UNIX to create, organize, and access files, while he uses the Emmy host for efficient emulation. Instruction times for the Nova emulation are provided together with an analysis of the host's effectiveness in supporting the emulation. An appendix describes the emulation of the Nova 3 front panel for laboratory users interested in operating the emulator.

7163 (UCID—17623(Rev.1)) **BIHI: bicubic hermite interpolation code.** Dickinson, R.P. Jr.; Carlson, R.E.; Fritsch, F.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1978. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

BIHI is a bivariate interpolation code which constructs a piecewise bicubic function that interpolates to a given set of data values arranged over a rectangular grid.

7164 (UCID—17886) **DDT (dynamic debugging technique) and TDT (tracing debugging technique) for PDP-11 systems.** Bering, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jun 1978. Contract W-7405-ENG-48. 36p. Dep. NTIS, PC A03/MF A01.

Two debugging aids for developers of applications and systems software on PDP-11 series computers are described. Both debuggers are extensions of Digital Equipment Corporation's ODT (Octal Debugging Technique), and are based on an undocumented, unsupported debugger obtained through DEC. The intent of this paper is to describe these debuggers in a functional sense, discuss the modifications made at LLL to enhance the operation of these debuggers, and to serve as a user's manual for persons developing PDP-11 software.

7165 (UCID—17937(Pt.1)) **PPOS: a master control data base preprocessor, a description and explanation of the DNA project general programmer note.** Chato, D.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Aug 1978. Contract W-7405-ENG-48. 38p. Dep. NTIS, PC A03/MF A01.

MASTER CONTROL (MC) is the primary data base management system at LLL. Field Command, Defence Nuclear Agency (FCDNA) Military Liaison Office each year receives massive (20000 to 40000 lines) amounts of weapon transactions data on tape. DNA is involved in a study of the DOD maintenance and transportation costs associated with nuclear weapons and requires a data base management system to process the data. However, the weapon data must be translated, modified, and reformatted for MC use. Because of the need to manipulate the data, and because of the quantity of data, a preprocessor called PPOS was built to manage the data and make use of time and memory-saving schemes. In addition, some MC command files were developed for operating on the data base. (RWR)

7166 (UCID—30164) **Average day with your friendly Livermore Time-Sharing System.** Whitten, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Apr 1978. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

This document takes the user through all the necessary steps to have a successful day on the Livermore Time-Sharing System (the LLL Octopus computer network). Interactions covered in the script include logging on and off; using utility routines; and creating, editing, compiling, running, and debugging a program. Detailed information is included on the log-on (identification or ID line) procedure, CDC-7600 system queries (CTRL-E requests), and the major LRLTRAN programing language statements.

7167 (UCRL—80664) **Multiclass arbitrating scheduler for the BOSS operating system.** Requa, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1978. 19p. (CONF-781023—1). Dep. NTIS, PC A02/MF A01.

From 2. symposium on operating systems; Le Chesnay, France (2 Oct 1978).

A method is given for deriving a set of multiclass scheduling equations that can arbitrate class allocations according to class loads. The method is illustrated by deriving a set of equations utilized in the BOSS operating system for the CDC STAR-100 computer system. A brief description is given of how the equations are interfaced to the environment provided by the BOSS operating system.

7168 (UCRL—80893) **Speckle imaging using the principle value decomposition method.** Sherman, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Aug 1978. Contract W-7405-ENG-48. 10p. (CONF-780829—5). Dep. NTIS, PC A02/MF A01.

From 22. symposium and instrument display; San Diego, CA, USA (28 Aug 1978).

Obtaining diffraction-limited images in the presence of atmospheric turbulence is a topic of current interest. Two types of approaches have evolved: real-time correction and speckle imaging. A speckle imaging reconstruction method was developed by use of an "optimal" filtering approach. This method is based on a nonlinear integral equation which is solved by principle value decomposition. The method was implemented on a CDC 7600 for study. The restoration algorithm is discussed and its performance is illustrated. 7 figures.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 5998, 6087, 6958, 6990, 7152, 7153

7169 (LBL—7953, pp 69-90) **Analysis of update synchronization for multiple copy data-bases.** Gelenbe, E. (Univ. of Paris, Orsay, France); Sevcik, K. Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

A formal model allowing a precise definition of coherence and promptness in a multiple copy information system is presented and used to analyze a class of update synchronization techniques. 1 figure.

7170 (LBL—7953, pp 91-107) **Query processing on a distributed database.** Hevner, A.R.; Yao, S.B. (Purdue Univ., West Lafayette, IN). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Query processing in a distributed system consists of an arrangement of local data processing and data movements within the system. Two cost measures are used to judge the quality of a data processing and data movement strategy for a given query. The cost measures are response time and total time of query processing. A graphing method is introduced in order to visualize the costs of distributed query processing. Under various system assumptions algorithms are developed that attempt to minimize data movement costs. Examples are given in which these algorithms find movement strategies for a given query. Costs are compared. 1 table.

7171 (LBL—7953, pp 108-119) **Performance comparison of two update algorithms for distributed databases.** Garcia-Molina, H. (Stanford Univ., CA). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Several algorithms have been suggested for updating redundant data in a distributed database. This paper analyzes and compares the performance of two of these algorithms in the case of completely duplicated databases in a no-failure, update-only environment. One of the algorithms is a centralized locking algorithm, while the other is a distributed voting algorithm. The algorithms are studied through detailed simulations. However, the results obtained can also be approximated by an analytic technique based on a queuing model. 10 figures.

7172 (LBL—7953, pp 189-205) **Formal model of concurrency control mechanisms for database systems.** Bernstein, P.A.; Shipman, D.W. (Computer Corp. of America, Cambridge, MA). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

In a database system, an arbitrary interleaving of transactions can lead to an inconsistent database state. This spurious behavior can be prevented by a variety of proposed synchronization mechanisms. Insight into these mechanisms is gained by analyzing them in a simple centralized system which permits one read operation and one write operation per transaction. It is shown why locking mechanisms lead to correct operation and that two proposed mechanisms are actually special cases of locking. Conflict graph analysis, the method used in the SDD-1 distributed database system, is also examined; its correctness is proven; and it is shown that it is not a locking mechanism.

7173 (LBL—7953, pp 206-214) **Maximally concurrent transaction processing.** Minoura, T. (Stanford Univ., CA). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

The problem of concurrent processing of transactions in a database system is discussed. A necessary and sufficient condition for the concurrent processing of transactions without violating consistency is shown, and a maximally concurrent and deadlock-free synchronization scheme which makes use of the above condition is given. The limitation of the more common locking mechanism is studied, and the necessity of two-phase locking for consistency is proved when locking is the only mechanism used. NP-completeness of the shortest-time scheduling problem is also discussed.

7174 (LBL—7953, pp 215-232) **Locking and deadlock detection in distributed databases.** Menasce, D.A.; Muntz, R.R. (Univ. of California, Los Angeles). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

This paper describes two protocols for the detection of deadlocks in distributed databases—a hierarchically organized one and a distributed one. A graph model which depicts the state of execution of all transactions in the system is used by both protocols. A cycle in this graph is a necessary and sufficient condition for a deadlock to exist. Nevertheless, neither protocol requires that the global graph be built and maintained in order for deadlocks to be detected. In the case of the hierarchical protocol, the communications cost can be optimized if the topology of the hierarchy is appropriately chosen.

7175 (LBL—7953, pp 235-258) **Concurrency control and consistency of multiple copies of data in distributed INGRES.** Stonebraker, M. (Univ. of California, Berkeley). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Algorithms for ensuring the consistency of a distributed relational data base subject to multiple concurrent updates are presented. Also included are mechanisms to update multiple copies of objects correctly and to continue operation when fewer than all machines in the network are operational. This paper contains significant portions of the design for a distributed data base version of INGRES. 1 figure.

7176 (LBL—7953, pp 259-272) **Algorithms for distributed data-sharing systems which use tickets.** Le Lann, G. (IRIA, Le Chesnay, France). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Data coherence and resiliency are natural requirements for a distributed data-sharing system (DDSS). Achieving data coherence implies that constraints of data internal integrity and mutual consistency for multiple copy data are met. How this can be done depends on the organization of the system under consideration. First, a description of two DDSS architectures is given. Then a solution to the problem of maintaining data coherence in a DDSS is presented. This solution is based on the utilization of a ticketing scheme which achieves a distributed and sequential identification of requests entering the system. This scheme is shown to survive failures. Four different algorithms are derived from this scheme, each allowing for a different degree of parallelism within the system. 2 figures, 1 table.

7177 (LBL—7953, pp 273-285) **Proposal for distributed concurrency control for partially redundant distributed data base systems.** Badal, D.Z.; Popek, G.J. (Univ. of California, Los Angeles). Aug 1978.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

In Proceedings of the third Berkeley workshop on distributed data management and computer networks.

Two distributed concurrency control methods for partially redundant distributed data base systems are described. The proposed methods are shown to maintain internal and external consistency of the data base, to avoid deadlocks, and to be robust in case of network partition(s) and node(s) or communication link(s) failures. The protocols require low synchronization overhead, and they support an automatic recovery to a consistent state in case of network partition(s).

7178 (ORNL—5397) **Nuclear Structure References (NSR) file.** Ewbank, W.B. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A03/MF A01.

The use of the Nuclear Structure References file by the Nuclear Data Project at ORNL is described. Much of the report concerns format information of interest only to those preparing input to the system or otherwise needing detailed knowledge of its internal structure. 17 figures. (RWR)

7179 (TID—4585-R1) **Energy Information Data Base: corporate author entries.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jun 1978. 480p. Dep. NTIS, PC A21/MF A01.

The DOE Energy Information Data Base has been created and is maintained by the DOE Technical Information Center. One of the controls for information entered into the base is the standardized name of the corporate entity or the corporate author. The purpose of this list of authorized or standardized corporate entries is to provide a means for the consistent citing of the names of organizations in bibliographic records. It also serves as a guide for users who retrieve information from a bibliographic data base and who want to locate information originating in particular organizations. This authority is a combination of entries established by the Technical Information Center and the International Atomic Energy Agency's International Nuclear Information System (INIS). The format calls, in general, for the name of the organization represented by the literature being cataloged to be cited as follows: the largest element, the place, the smallest element, e.g., Brigham Young Univ., Provo, Utah (USA), Dept. of Chemical Engineering. Code numbers are assigned to each entry to provide manipulation by computer. Cross references are used to reflect name changes and invalid entries.

7180 (UCRL—80769) **Relational data base management system for scientific data.** Jones, S.E.; Ries, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1978. Contract W-7405-ENG-48. 15p. (CONF-780587—4). Dep. NTIS, PC A02/MF A01.

From 6. CODATA conference; Palermo, Italy (22 May 1978).

LLL is developing FRAMIS, a prototype of a complete scientific DBMS. FRAMIS is based on the relational model and supports FUL, an augmented relational algebraic language. It offers a high-level, interactive interface to the data base which is suitable for scientists and others who are not experienced programers. FRAMIS is particularly suitable for ad hoc analysis of data containing complex associations within it. 1 figure.

7181 **Information analysis center concept: products, services, and pricing policies.** Gerstner, H.B.; Huff, J.E.; Ulrikson, G.U. (Oak Ridge National Lab., TN). *Am. Lab.;* **9**: 41-48(Jul 1977).

Described herein is an approach to the handling of information support activities. An overview of the Information Center Complex (ICC) is presented, followed by a more detailed description of the Toxicology Information Response Center (TIRC).

7182 **Two new energy information bases: ERDI/West, an energy research and development inventory for the West; and ESIDD, energy saving and investment data and documents.** Rosenfeld, A.H.; Winkelmann, F.C. (Lawrence Berkeley Lab., CA). *CODATA Bull.;* No. 23, 1-4(May 1977).

From 5. international CODATA conference; Boulder, CO, USA (Jun 1976).

Two new energy information bases, ERDI/West and ESIDD, are described. ERDI/West is a computer-based inventory destined to cover all energy-related activity in the Western Region of the U.S. It now contains information on projects and investigators in California, but ultimately will also have document and data files. ERDI/West is expected to be a useful tool for administrators, legislators, and researchers in planning, funding, or conducting energy research and development in the West. The second data base, ESIDD, Energy Saving and Investment Data and Documents, contains up-to-date information on existing documents and data on annual energy savings and required investment for different energy conservation measures in homes, commercial buildings, industry, and in home appliance selection. To illustrate the importance of cost-to-saving data for setting energy priorities, two energy strategies are compared: producing more energy by building a $1.6 billion synthetic gas plant conserving energy by adding extra insulation to existing homes and appliances.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

Adelphi Research Center, Inc., Garden City, NY (USA)
Feasibility study of using a coal/water/oil emulsion as a clean liquid fuel. Phase 2, second year. Interim report, October—November 1977, 4:5138 (FE—2437-5)

Aerochem Research Labs., Inc., Princeton, NJ (USA)
Development of a model and computer code to describe solar grade silicon production processes. Second quarterly report, January 1—March 31, 1978, 4:5483 (DOE/JPL/954862—2)

Agbabian Associates, El Segundo, CA (USA)
Geotechnical and strong motion earthquake data from U.S. accelerograph stations: Pasadena (CIT Millikan Library), Santa Barbara County Court House, Taft (Lincoln School Tunnel), and Hollister (Melendy Ranch Barn), California, 4:6822 (NUREG—0029(Vol.2))

Alaska Univ., Fairbanks (USA). Inst. of Marine Science
Transport and reaction of heavy metals in Alaskan fjord-estuaries. Annual report, April 1, 1977—May 31, 1978, 4:6629 (RLO—2229-T1-45)

Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office
Liquid-fluidized-bed heat exchanger design parameters, 4:5660 (ICP—1153)
Rover process verification studies: transport of dry solids, 4:5301 (ICP—1166)
Ruthenium behavior during calcination, 4:5329 (ICP—1164)

Allied-General Nuclear Services, Barnwell, SC (USA)
Studies and research concerning BNFP: LWR spent fuel storage, 4:5310 (AGNS—1040-1.4-20)

American Inst. of Plant Engineers, Cincinnati, OH
1977 AIPE annual convention proceedings, 4:5996 (CONF-7706129—)

Ames Lab., IA (USA)
Determination of the energy gap in $Nb_{0.75}Zr_{0.25}$ using a proximity tunneling method, 4:6236 (IS-M—134)
Low temperature heat capacity studies on intermetallic and semimetallic rare earth compounds, 4:6259 (IS-M—148)
Simultaneous determination of minor and trace elements in coal using instrumental neutron activation analysis, 4:6303 (IS-T—817)

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Magnetization effects in electron cooling, 4:6474 (BNL-tr—663)

Argonne National Lab., Idaho Falls, ID (USA)
Compliation of data from EBR-II natural-circulation-test procedure EX-140, Section IV, Addendum 1A, 4:5946 (ANL/EBR—101)

Argonne National Lab., IL (USA)
Abandoned mine land reclamation plan, 4:5087 (ANL/LRP-TM—8)
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Benefit—cost analysis of new source performance standards, 4:6522 (ANL/EES-TM—10)
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Commercialization planning for the lithium/metal sulfide battery, 4:5993 (CONF-7710171—1)
Critical heat flux measurements with sodium heating and low water flowrate, 4:5791 (ANL-CT—78-39)
Effect of sodium chloride on the reaction of $SO_2/0_2$ mixtures with limestones and dolomites, 4:5072 (ANL/CEN/FE—78-8)
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Fusion Power Program. Quarterly progress report, January—March 1978, 4:7077 (ANL/FPP—78-1)
Instrumentation and process control for fossil demonstration plants. Annual technical progress report, October 1976—September 1977, 4:4968 (ANL-FE—49622-12)
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Workshop on dating old ground water, 4:6616 (Y/OWI/SUB—78/55412)

ARO, Inc., Arnold Air Force Station, TN (USA)
Final report on the design of the MHD generator channel for the high performance demonstration experiment, 4:6115 (FE—1542-4)

Atlantic Richfield Hanford Co., Richland, WA (USA)
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Atomics International Div., Golden, CO (USA). Rocky Flats Plant
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Evaluation of the plastic characteristics of piping products in relation to ASME code criteria, 4:5858 (NUREG/CR—0261)

Battelle Pacific Northwest Labs., Richland, WA (USA)
Bench scale research in thermochemical conversion of biomass to liquids in support of the Albany, Oregon, Experimental Facility, 4:5504 (TID—28415)
Characterization on the high-level waste glasses. Annual report, 4:5325 (PNL—2625)
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State-of-the-technology review of fuel-cladding interaction, 4:5759 (COO—4066-2)

BCS Richland, Inc., WA (USA). Scientific Consulting and Programming Dept.
Model of contaminant diffusion from a finite line source in a dense basalt stratum to an overlying permeable interbed, 4:5315 (RHO-BWI-C—3)

Bendix Corp., Kansas City, MO (USA)
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Bendix Field Engineering Corp., Grand Junction, CO (USA)
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Preliminary report on uranium and thorium content of intrusive rocks in northeastern Washington and northern Idaho, 4:5278 (GJBX—89(77)R)

Bettis Atomic Power Lab., West Mifflin, PA (USA)
Properties of thoria and thoria-urania: a review (LWBR Development Program), 4:6280 (WAPD-TM—1340)
REL02: a Monte Carlo technique to calculate failure probability, 4:6252 (WAPD-TM—1233)

Booz-Allen Applied Research, Inc., Bethesda, MD (USA)
Review and analysis of oil shale technologies. Volume IV. Aboveground or surface technology, 4:5252 (FE—2343-6(Vol.4))
Review and analysis of oil shale technologies. Volume 5. Appendixes and bibliography, 4:5245 (FE—2343-6(Vol.5))

Braun (C.F.) and Co., Alhambra, CA (USA)
Factored estimates for eastern coal commercial concepts. Technical appendix II: engineered equipment descriptions. Interim report. Series No. IV: B-2, 4:4983 (FE—2240-31(App.2))

Brigham Young Univ., Provo, UT (USA). Thermochemical Inst.
Determination of sulfur speciation in industrial aerosols in an SO_2 rich environment. Progress report, 15 June 1977—14 June 1978, 4:6536 (COO—2988-10)

Brookhaven National Lab., Upton, NY (USA)
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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

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EY-76-C-02-0893-031		General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.
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EY-76-C-02-1545		Ohio State Univ., Columbus (USA). Dept. of Physics
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EY-76-C-02-2263		Rasor Associates, Inc., Sunnyvale, CA (USA)
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	4:6128	TID—28568
EY-76-C-02-2477		United Engineers and Constructors, Inc., Philadelphia, PA (USA)
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EY-76-C-02-2670		Thermo Electron Corp., Waltham, MA (USA)
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EY-76-C-02-2952		United Technologies Corp., Windsor Locks, CT (USA). Hamilton Standard Div.
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EY-76-C-02-2974		Westinghouse Electric Corp., Pittsburgh, PA (USA). Water Reactor Divisions
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EY-76-C-02-3045-012		Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.
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EY-76-C-02-3045-032		Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.
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EY-76-C-02-3056		Thermo Electron Corp., Waltham, MA (USA)
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EY-76-C-02-3064		Harvard Univ., Cambridge, MA (USA). Dept. of Physics
	4:6951	COO—3064-11
EY-76-C-02-3073		Princeton Univ., NJ (USA). Plasma Physics Lab.
	4:7018	PPPL—1466
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EY-76-C-03-0893	**General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.**	
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EY-76-C-03-1018	**Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies**	
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EY-76-C-03-1141	**Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.**	
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EY-76-C-03-1225-010	**Energy and Environmental Analysis, Inc., Arlington, VA (USA)**	
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EY-76-C-13-1664	**Bendix Field Engineering Corp., Grand Junction, CO (USA)**	
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EY-76-C-15-2395	**General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.**	
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EY-76-S-02-1340	**Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science**	
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EY-76-S-02-2007	**Illinois Univ., Urbana (USA). Dept. of Nuclear Engineering**	
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EY-76-S-02-2128	**Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering**	
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EY-76-S-02-4122	**Masssachusetts Univ., Amherst (USA). Dept. of Civil Engineering**	
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EY-76-S-03-0034-149	**California Univ., Irvine (USA). Dept. of Physics**	
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NAS-7-100-954873	Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center	
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	4:6293	No. 40, 258-262(1978)
	4:6294	No. 40, 263-268(1978)
	4:6295	No. 40, 276-282(1978)
	4:6296	No. 40, 311-316(1978)
	4:6994	No. 40, 324-329(1978)
	4:6995	No. 40, 130-142(1978)
CONF-770966-	(Solar industrial process heat symposium, College Park, MD, USA, 19-20 Sep 1977)	
	4:5576	Dep. NTIS, PC A11/MF A01
CONF-770980-	(10. world energy conference on availability and rational use of energy resources, Istanbul, Turkey, 19-24 Sep 1977)	
1	4:5445	Dep. NTIS (US Sales Only), PC A02/MF A01
CONF-771042-	(3. ERDA statistical symposium, Richland, WA, USA, 26-28 Oct 1977)	
	4:7138	Dep. NTIS, PC A09/MF A01
CONF-771089-	(Particles and fields meeting, Argonne, IL, USA, 6-8 Oct 1977)	
	4:6841	No. 43, 77-86(1978)
	4:6845	No. 43, 87-101(1978)
	4:6888	No. 43, 297-337(1978)
	4:6889	No. 43, 355-373(1978)
	4:6890	No. 43, 413-440(1978)
	4:6891	No. 43, 457-466(1978)
	4:6896	No. 43, 15-48(1978)
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	4:6898	No. 43, 375-385(1978)
	4:6903	No. 43, 193-238(1978)
	4:6904	No. 43, 243-270(1978)
	4:6905	No. 43, 271-286(1978)
	4:6911	No. 43, 103-116(1978)
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	4:6948	No. 43, 145-165(1978)
	4:6953	No. 43, 497-501(1978)
	4:7002	No. 43, 65-75(1978)
CONF-7710136-	(4. UMR-DNR conference on energy, Rolla, MO, USA, 11-13 Oct 1977)	
	4:5997	University of Missouri, Rolla, MO
CONF-7710145-	(Solar technology: moving it into the market place, Vail, CO, USA, 20-22 Oct 1977)	
(Summ.)	4:5469	Dep. NTIS, PC A03/MF A01
CONF-7710157-	(5. European logging symposium, Paris, France, 20-21 Oct 1977)	
	4:6491	Paris; Societe pour l'Avancement de l'Interpretation des Diagraphies (1977).
CONF-7710163-	(Contractors meeting, Ballston Spa, NY, USA, 25 Oct 1977)	
2	4:5495	Dep. NTIS, PC A03/MF A01
CONF-7710169-	(Symposium on oil/environment, Halifax, MS, USA, 11-14 Oct 1977)	
1	4:5215	*See* BNWL-SA-6559
CONF-7710171-	(Symposium on lithium needs and resources, Corning, NY, USA, 12-14 Oct 1977)	
1	4:5993	Dep. NTIS, PC A02/MF A01
CONF-771170-	(3. post-accident heat removal information exchange, Argonne, IL, USA, 2-4 Nov 1977)	
	4:5897	*See* ANL-78-10
CONF-771175-	(Symposium on alcohol fuel technology, Wolfsburg, F.R. Germany, 21-23 Nov 1977)	
	4:5426	Dep. NTIS, PC A22/MF A01
CONF-771181-	(Seminar on thermochemical conversion of biomass residues, Richland, WA, USA, 29-30 Nov 1977)	
1	4:5410	*See* BNWL-SA-6485
CONF-771187-	(4. FACSS, Detroit, MI, USA, 7-11 Nov 1977)	
1	4:6322	*See* BDX-613-1940
CONF-771222-	(IAEA symposium on natural fission reactors, Paris, France, 19-21 Dec 1977)	
15	4:5274	*See* LA-tr-78-34
CONF-771257-	(American Geophysical Union meeting, San Francisco, CA, USA, 5-9 Dec 1977)	
1	4:6105	*See* COO-1340-57
CONF-780109-	(Technology for energy conservation, Albuquerque, NM, USA, 23-27 Jan 1978)	
9	4:5668	*See* BNWL-SA-6554
CONF-780117-	(Solar neutrino conference, Upton, NY, USA, 5-7 Jan 1978)	
3	4:6843	*See* BNL-24673
CONF-780145-	(Orbis scientiae conference, Coral Gables, FL, USA, 15-20 Jan 1978)	
2	4:6951	*See* COO-3064-11
CONF-780203-	(1. joint U.S./Japan LMFBR steam generator seminar, Tokyo, Japan, 13-24 Feb 1978)	
2	4:5808	*See* GEFR-SP-044
9	4:5802	Dep. NTIS, PC A03/MF A01
CONF-780208-	(Society of Automotive Engineers International Automotive Engineering Congress and Exposition, Detroit, MI, USA, Feb 1978)	
66	4:6217	Warrendale, PA; Society of Automotive Engineers, Inc. (1978).
80	4:6222	Warrendale, PA; Society of Automotive Engineers, Inc. (1978).
CONF-780222-	(5. energy technology conference, Washington, DC, USA, 27 Feb-1 Mar 1978)	
8	4:5696	*See* DOE/NASA/1059-78/1
CONF-780231-	(Utility rate structuring, Washington, DC, USA, 28 Feb 1978)	
	4:6096	Dep. NTIS, PC A09/MF A01
CONF-780232-	(IAEA meeting on sodium removal and decontamination, Richland, WA, USA, 14-16 Feb 1978)	
3	4:5809	*See* HEDL-SA-1429FP
4	4:5811	*See* HEDL-SA-1452
CONF-780305-	(American Chemical Society conference, Anaheim, CA, USA, 12-17 Mar 1978)	
P2	4:4941	Washington, DC; American Chemical Society (1978).
P2	4:4942	23: No. 1, 368-370(Feb 1978)
P2	4:4952	23: No. 1, 163-174(Feb 1978)
P2	4:4962	23: No. 1, 277-287(Feb 1978)
P2	4:4963	23: No. 1, 288-306(Feb 1978)
P2	4:5050	23: No. 1, 264-276(Feb 1978)
P2	4:5051	23: No. 1, 343-350(Feb 1978)
P2	4:5056	23: No. 1, 175-182(Feb 1978)
P2	4:5057	23: No. 1, 307-321(Feb 1978)
P2	4:5199	23: No. 1, 36-45(Feb 1978)
P2	4:5200	23: No. 1, 46-64(Feb 1978)
P2	4:5201	23: No. 1, 65-79(Feb 1978)
P2	4:5202	23: No. 1, 82-92(Feb 1978)
P2	4:5203	23: No. 1, 113-119(Feb 1978)
P2	4:5204	23: No. 1, 183-196(Feb 1978)
P2	4:5205	23: No. 1, 351-360(Feb 1978)
P2	4:5207	23: No. 1, 142-153(Feb 1978)
P2	4:5208	23: No. 1, 197-207(Feb 1978)
P2	4:5209	23: No. 1, 225-240(Feb 1978)
P2	4:5214	23: No. 1, 93-100(Feb 1978)
P2	4:5225	23: No. 1, 361-367(Feb 1978)
P2	4:5243	23: No. 1, 154-158(Feb 1978)
P2	4:5257	23: No. 1, 208-217(Feb 1978)
P2	4:5258	23: No. 1, 260-261(Feb 1978)
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P2	4:5261	23: No. 1, 30-35(Feb 1978)
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P2	4:5267	23: No. 1, 253-259(Feb 1978)
P2	4:5269	23: No. 1, 241-252(Feb 1978)
P2	4:6083	23: No. 1, 371-378(Feb 1978)
P2	4:6084	23: No. 1, 396-403(Feb 1978)
P2	4:6101	23: No. 1, 379-395(Feb 1978)
P2	4:6312	23: No. 1, 120-127(Feb 1978)
P2	4:6359	23: No. 1, 106-112(Feb 1978)
P2	4:6360	23: No. 1, 128-140(Feb 1978)
P2	4:6361	23: No. 1, 159-162(Feb 1978)
P2	4:6362	23: No. 1, 218-224(Feb 1978)
CONF-780307-	(17. symposium on engineering aspects of MHD, Stanford, CA, USA, 27-29 Mar 1978)	
10	4:6120	*See* PNL-SA-6851
12	4:6123	Dep. NTIS, PC A02/MF A01

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13	4:6124	Dep. NTIS, PC A02/MF A01
CONF-780337-		(2. national passive solar conference, Philadelphia, PA, USA, 15-19 Mar 1978)
7	4:5570	*See* LA-UR-78-1589
CONF-780338-		(3. conference on new results in high energy physics, Nashville, TN, USA, 6-8 Mar 1978)
5	4:6894	*See* SLAC-PUB-2104
CONF-780349-		(5. conference on noise in physical systems, Bad Nauheim, F.R. Germany, 13-16 Mar 1978)
2	4:6407	*See* LBL-8030
CONF-780353-		(13. high energy hadronic interactions sessions, Les Arcs, France, 12-24 Mar 1978)
4	4:6919	*See* SLAC-PUB-2132
CONF-780443-		(2. conference on alternate energy, Palm Springs, CA, USA, 8-10 Apr 1978)
2	4:5990	*See* LBL-7066
CONF-780453-		(Neutrinos, West Lafayette, IN, USA, 28 Apr-2 May 1978)
7	4:6926	*See* SLAC-PUB-2131
8	4:6895	*See* SLAC-PUB-2127
11	4:6842	*See* BNL-24629
CONF-780465-		(Reactor congress, Hannover, F.R. Germany, 4-7 Apr 1978)
1	4:5842	*See* ANL-Trans-1135
CONF-780476-		(3. conference on application of solar energy, Huntsville, AL, USA, 17-19 Apr 1978)
1	4:5630	Dep. NTIS, PC A02/MF A01
CONF-780485-		(Industrial coal conference, Lexington, KY, USA, 26-27 Apr 1978)
4	4:5132	Lexington, KY; University of Kentucky (1978).
7	4:5077	Lexington, KY; University of Kentucky (1978).
9	4:5737	Lexington, KY; University of Kentucky (1978).
11	4:5717	Lexington, KY; University of Kentucky (1978).
CONF-780495-		(Symposium on current trends in the theory of fluids, Tallahassee, FL, USA, 6-7 Apr 1978)
1	4:6952	*See* SLAC-PUB-2121
CONF-780508-		(3. meeting on the technology of controlled thermonuclear fusion, Santa Fe, NM, USA, 9-11 May 1978)
60	4:7099	*See* PPPL-1451
66	4:7079	*See* ANL/FPP/TM-112
67	4:7079	*See* ANL/FPP/TM-112
68	4:7079	*See* ANL/FPP/TM-112
71	4:5375	*See* BNL-24669
CONF-780549-		(Symposium on biotechnology in energy production, Gatlinburg, TN, USA, 10-12 May 1978)
3	4:5390	Dep. NTIS, PC A02/MF A01
CONF-780587-		(6. CODATA conference, Palermo, Italy, 22-25 May 1978)
3	4:6337	*See* LBL-7827
4	4:7180	*See* UCRL-80769
CONF-7805100-		(Workshop on the electrocatalysis of fuel cell reactions, Upton, NY, USA, 15-16 May 1978)
1	4:6132	Dep. NTIS, PC A02/MF A01
CONF-7805111-		(Workshop on high resolution heavy ion physics at 20-100 MeV/A, Saclay, France, 31 May-2 Jun 1978)
1	4:6975	Dep. NTIS, PC A02/MF A01
CONF-7805112-		(Workshop on supernova and supernova remnants, Sicily, Italy, 14-23 May 1978)
1	4:6838	*See* LA-UR-78-2026
2	4:6839	*See* LA-UR-78-2030
CONF-7805116-		(Rocky Mountain coal symposium, Billings, MT, USA, 10 May 1978)
1	4:5016	*See* UCRL-81382
CONF-7805118-		(EPRI workshop on fly ash research needs, Palo Alto, CA, USA, 24-25 May 1978)
1	4:5090	Dep. NTIS, PC A03/MF A01
CONF-7805119-		(Power burst facility contractors meeting, Silver Springs, MD, USA, 10 May 1978)
1	4:5871	*See* HEDL-SA-1513
CONF-7805122-		(1. symposium on acoustical holography, Key Biscayne, FL, USA, 30 May-2 Jun 1978)
1	4:6242	*See* HEDL-SA-1515
CONF-780622-		(ANS annual meeting, San Diego, CA, USA, 18-23 Jun 1978)
20	4:6414	*See* SAND-78-0228C
49	4:5316	*See* SAND-78-0225C
55	4:5955	*See* HEDL-SA-1463FP
58	4:5810	*See* HEDL-SA-1447-S
72	4:5298	*See* DPSPU-78-30-3
CONF-780639-		(Analysis for solar heating and cooling, San Diego, CA, USA, 27-29 Jun 1978)
5	4:5460	*See* SAND-78-1190C
7	4:5589	*See* UCRL-81348
CONF-780641-		(2. geothermal conference, Taos, NM, USA, 20-23 Jun 1978)
2	4:5661	*See* LBL-7077
CONF-780644-		(3. conference on clustering aspects of nuclear structure and nuclear reactions, Winnipeg, Canada, 19-23 Jun 1978)
2	4:6965	*See* LBL-7598
CONF-780650-		(1. symposium on ultrasonic materials characterization, Gaithersburg, MD, USA, 7-9 Jun 1978)
2	4:6434	*See* UCRL-81194
CONF-780675-		(Symposium on ion implantation--new prospects for materials modification, Yorktown Heights, NY, USA, 14 Jun 1978)
1	4:6277	*See* SAND-78-1199C
CONF-780681-		(61. chemical conference, Winnipeg, Manitoba, Canada, 4-7 Jun 1978)
1	4:6323	*See* LBL-7688
CONF-7806103-		(38. conference on physical electronics, Gatlinburg, TN, USA, 19-21 Jun 1978)
1	4:6261	*See* LBL-7639
CONF-7806104-		(Electric hybrid vehicle contractors coordinating meeting, Germantown, MD, USA, 26-28 Jun 1978)
1	4:6014	*See* ANL/EES-CP-15
CONF-7806105-		(Hemopoietic stem cell symposium, Upton, NY, USA, 12-14 Jun 1978)
2	4:6778	*See* BNL-24734
CONF-7806106-		(IAEA meeting on the use of nuclear radiation for the elucidation of chemical bonding, Cambridge, UK, 27-29 Jun 1978)
1	4:6334	*See* BNL-24714
CONF-7806107-		(2. symposium on fuels from biomass, Troy, NY, USA, 20-22 Jun 1978)
1	4:5435	*See* LBL-7847
CONF-7806111-		(Meeting on hadron physics at high energies, Marseille, France, 5-9 Jun 1978)
1	4:6937	*See* COO-3227-71
CONF-7806112-		(22. astrophysical symposium, Liege, Belgium, 20-22 Jun 1978)
1	4:6840	*See* LA-UR-78-2286
CONF-780702-		(Symposium on heating in toroidal plasmas, Grenoble, France, 3-7 Jul 1978)
7	4:7103	*See* UCRL-81242
CONF-780708-		(Geothermal Resources Council meeting, Hilo, HI, USA, 25-28 Jul 1978)
22	4:5663	*See* UCRL-81022
CONF-780711-		(11. AIAA fluid and plasma dynamics conference, Seattle, WA, USA, 10-12 Jul 1978)
2	4:6819	*See* SAND-78-0011C
CONF-780722-		(9. symposium on effects of radiation in structural materials, Richland, WA, USA, 10-14 Jul 1978)
2	4:6272	Dep. NTIS, PC A03/MF A01
3	4:6275	*See* HEDL-SA-1462
5	4:5761	*See* HEDL-SA-1475
8	4:6273	Dep. NTIS, PC A03/MF A01
11	4:6278	*See* UWFDM-252
CONF-780723-		(4. underground coal conversion symposium, Steamboat Springs, CO, USA, 17-20 Jul 1978)
	4:4995	*See* SAND-78-0941
CONF-780727-		(Conference on computer mapping software and data bases, Cambridge, MA, USA, 26 Jul 1978)
1	4:7140	Dep. NTIS, PC A03/MF A01
CONF-780730-		(Geotechnical assessment and instrumentation needs symposium, Berkeley, CA, USA, 16-20 Jul 1978)
2	4:5342	*See* Pub-246
CONF-780732-		(Metallographic Society Technical conference, Montreal, Canada, 16-19 Jul 1978)
1	4:6263	*See* MLM-2540(OP)
CONF-780734-		(Workshop on analytical electron microscopy, Ithaca, NY, USA, 24-28 Jul 1978)
2	4:6870	Dep. NTIS, PC A02/MF A01

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3	4:6477	Dep. NTIS, PC A02/MF A01
CONF-780738-	(4. conference on crystal growth, Gaithersburg, MD, USA, 16-20 Jul 1978)	
1	4:6239	Dep. NTIS, PC A02/MF A01
CONF-780740-	(Management, stabilization, and environmental impact of uranium mill trailings, Albuquerque, NM, USA, 24-28 Jul 1978)	
3	4:5337	Dep. NTIS, PC A03/MF A01
CONF-780741-	(Frontiers of biological energetics; electrons to tissues, Philadelphia, PA, USA, 19-21 Jul 1978)	
2	4:6731	*See* BNL-24749
CONF-780748-	(Hydrogen for energy distribution, Chicago, IL, USA, 24-28 Jul 1978)	
1	4:5392	*See* BNL-24735
CONF-780749-	(Harvard computer graphics week conference, Cambridge, MA, USA, 23 Jul 1978)	
1	4:6072	*See* LBL-7937
CONF-780751-	(Cryogenic materials conference, Munich, F.R. Germany, 10-11 Jul 1978)	
1	4:6405	*See* LBL-7931
2	4:5752	*See* BNL-24634
CONF-780801-	(13. intersociety energy conversion engineering conference, San Diego, CA, USA, 20-25 Aug 1978)	
30	4:6173	Dep. NTIS, PC A02/MF A01
31	4:6198	Dep. NTIS, PC A02/MF A01
33	4:5136	Dep. NTIS, PC A02/MF A01
34	4:6174	Dep. NTIS, PC A03/MF A01
35	4:6152	Dep. NTIS, PC A02/MF A01
37	4:6163	Dep. NTIS, PC A02/MF A01
CONF-780802-	(American Statistical Association meeting, San Diego, CA, USA, 14-17 Aug 1978)	
7	4:6068	Dep. NTIS, PC A02/MF A01
CONF-780804-	(13. congress on high-speed photography and photonics, Tokyo, Japan, 20-25 Aug 1978)	
3	4:7019	*See* UCRL-80923
8	4:6433	*See* LA-UR-78-630
CONF-780806-	(17. symposium on combustion, Leeds, UK, 20-25 Aug 1978)	
3	4:6214	*See* UCRL-80593
CONF-780807-	(2. world hydrogen energy conference, Zurich, Switzerland, 21-24 Aug 1978)	
10	4:5385	Dep. NTIS, PC A02/MF A01
11	4:5386	Dep. NTIS, PC A04/MF A01
CONF-780808-	(Meeting of the American Section of the International Solar Energy Society, Denver, CO, USA, 28-31 Aug 1978)	
2	4:5623	*See* SAND-78-0117C
17	4:5622	*See* LBL-6974(Rev.)
18	4:5540	*See* BNL-24637
19	4:6153	*See* LBL-7828
20	4:6131	Dep. NTIS, PC A02/MF A01
CONF-780819-	(15. nuclear air cleaning conference, Boston, MA, USA, Aug 1978)	
3	4:6299	*See* RFP-2766
CONF-780822-	(27. conference on applications of x-ray analysis, Denver, CO, USA, 1-4 Aug 1978)	
2	4:6315	*See* UCRL-80937
CONF-780823-	(Conference on the electronic structure of the actinides, Grenoble, France, 30 Aug-2 Sep 1978)	
3	4:6381	*See* ORO-4447-075
4	4:6240	Dep. NTIS, PC A02/MF A01
5	4:6255	Dep. NTIS, PC A02/MF A01
6	4:6256	Dep. NTIS, PC A02/MF A01
7	4:6241	Dep. NTIS, PC A02/MF A01
8	4:6378	Dep. NTIS, PC A02/MF A01
CONF-780824-	(15. conference on low temperature physics, Grenoble, France, 23-29 Aug 1978)	
12	4:6236	*See* IS-M-134
CONF-780826-	(19. conference on high energy physics, Tokyo, Japan, 23-31 Aug 1978)	
1	4:6909	*See* ANL-HEP-PR-78-22
4	4:6910	*See* ANL-HEP-PR-78-24
5	4:6899	*See* ANL-HEP-CP-78-36
6	4:6900	*See* ANL-HEP-CP-78-37
CONF-780828-	(3. workshop on distributed data management and computer networks, San Francisco, CA, USA, 29-31 Aug 1978)	
	4:7144	*See* LBL-7953
CONF-780829-	(22. symposium and instrument display, San Diego, CA, USA, 28-31 Aug 1978)	
4	4:6398	*See* UCRL-81526
5	4:7168	*See* UCRL-80893
6	4:6479	*See* LA-UR-2129
CONF-780833-	(Conference on few body systems and nuclear forces, Graz, Austria, 24-30 Aug 1978)	
2	4:6938	*See* LA-UR-78-2227
CONF-780834-	(5. Bolton Landing conference, Lake George, NY, USA, 27-30 Aug 1978)	
2	4:6246	Dep. NTIS, PC A02/MF A01
CONF-780841-	(9. meeting on air pollution modeling and its application, Toronto, Canada, 28-31 Aug 1978)	
2	4:6527	*See* BNL-24844
CONF-780843-	(Conference on net energy analysis and energy modeling, Colorado Springs, CO, USA, 21-24 Aug 1978)	
1	4:6164	Dep. NTIS, PC A02/MF A01
2	4:6093	*See* BNL-24627
CONF-780844-	(Public oversite hearings on radioactive waste management, Washington, DC, USA, 10 Aug 1978)	
1	4:5319	Dep. NTIS, PC A02/MF A01
CONF-780902-	(American Chemical Society meeting, Miami, FL, USA, 10-15 Sep 1978)	
11	4:4979	Dep. NTIS, PC A02/MF A01
CONF-780907-	(4. conference on contamination, Washington, DC, USA, 10-14 Sep 1978)	
1	4:6538	*See* SAND-77-2120C
CONF-780911-	(1. meeting on muon spin rotation, Rorschach, Switzerland, 4-7 Sep 1978)	
1	4:6260	*See* LA-UR-78-1955
CONF-780913-	(Colloque of physics of the metallic rare earths, St. Pierre De Chartreuse, France, 4-7 Sep 1978)	
1	4:6259	*See* IS-M-148
3	4:6254	*See* BNL-24655
CONF-780917-	(WESCON meeting, Los Angeles, CA, USA, 12-14 Sep 1978)	
1	4:7110	*See* UCRL-81197
CONF-780926-	(3. symposium on neutron capture of gamma-ray spectroscopy, Upton, NY, USA, 18 Sep 1978)	
4	4:6959	Dep. NTIS, PC A02/MF A01
11	4:6963	*See* BNL-24695
CONF-780931-	(NATO institute on ion-molecule reactions, La Boule, France, 4-15 Sep 1978)	
1	4:6871	Dep. NTIS, MF A01
CONF-780932-	(Conference on ion beam modification of materials, Budapest, Hungary, 4-8 Sep 1978)	
1	4:6276	*See* SAND-78-0914C
CONF-780941-	(10. materials research symposium, Gaithersburg, MD, USA, 18-22 Sep 1978)	
1	4:5404	*See* UCRL-80832
CONF-780946-	(Driven magnetic fusion reactors, Erice, Italy, 18-26 Sep 1978)	
6	4:7090	*See* UCRL-81652
CONF-780955-	(Symposium on seed protein improvement in cereals and grain legumes, Neuherberg, F.R. Germany, 4-8 Sep 1978)	
1	4:6646	*See* BNL-24705
2	4:6645	*See* BNL-24704
CONF-781007-	(IAEA symposium on nuclear material safeguards, Vienna, Austria, 2-6 Oct 1978)	
5	4:5360	*See* LA-UR-78-2238
6	4:5969	*See* SAND-78-0456C
9	4:5363	*See* Y/DA-7740
CONF-781013-	(11. connector symposium, Cherry Hill, NJ, USA, 25-26 Oct 1978)	
1	4:6437	*See* SAND-78-0801C
CONF-781019-	(Symposium on future trends in computerized structural analysis and synthesis, Washington, DC, USA, 30 Oct-1 Nov 1978)	
1	4:7157	*See* ORO-3443-70
CONF-781023-	(2. symposium on operating systems, Le Chesnay, France, 2-5 Oct 1978)	
1	4:7167	*See* UCRL-80664
CONF-781024-	(CUBE symposium abstracts, Los Alamos, NM, USA, 4-6 Oct 1978)	
(Absts.)	4:7142	*See* LA-7417-C
CONF-781032-	(5. cost engineering congress, Utrecht, Netherlands, 30 Oct-1 Nov 1978)	
1	4:6395	*See* LA-UR-78-2171
CONF-781033-	(NS symposium, Washington, DC, USA, 18-20 Oct 1978)	
2	4:6475	*See* BNL-24440

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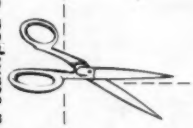

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